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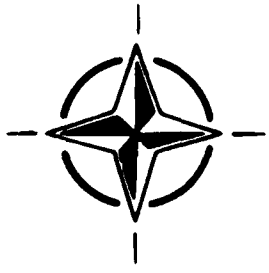
ADVISORY GROUP FOR AEROSPACE RESEARCH & DEVELOPMENT
7 RUE ANCELLE 92200 NEUILLY SUR SEINE FRANCE

AGARD CONFERENCE PROCEEDINGS 523

The Impact of Changing International Relations on the Scientific and Technical Community

(Incidence sur la Communauté Scientifique et Technique des Transformations en cours dans les Relations Internationales)

Papers presented at the Technical Information Panel Specialists' Meeting held at Eigtveds Pakhus, Copenhagen, Denmark 14th—15th October 1992.



NORTH ATLANTIC TREATY ORGANIZATION

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North Atlantic Treaty Organization
Organisation du Traité de l'Atlantique Nord

The Mission of AGARD

According to its Charter, the mission of AGARD is to bring together the leading personalities of the NATO nations in the fields of science and technology relating to aerospace for the following purposes:

- Recommending effective ways for the member nations to use their research and development capabilities for the common benefit of the NATO community;
- Providing scientific and technical advice and assistance to the Military Committee in the field of aerospace research and development (with particular regard to its military application);
- Continuously stimulating advances in the aerospace sciences relevant to strengthening the common defence posture;
- Improving the co-operation among member nations in aerospace research and development;
- Exchange of scientific and technical information;
- Providing assistance to member nations for the purpose of increasing their scientific and technical potential;
- Rendering scientific and technical assistance, as requested, to other NATO bodies and to member nations in connection with research and development problems in the aerospace field.

The highest authority within AGARD is the National Delegates Board consisting of officially appointed senior representatives from each member nation. The mission of AGARD is carried out through the Panels which are composed of experts appointed by the National Delegates, the Consultant and Exchange Programme and the Aerospace Applications Studies Programme. The results of AGARD work are reported to the member nations and the NATO Authorities through the AGARD series of publications of which this is one.

Participation in AGARD activities is by invitation only and is normally limited to citizens of the NATO nations.

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Theme

In the 90s we are experiencing a decade of changes in international relations, common markets, political structures, linguistic patterns and advanced technologies. Old barriers are breaking down.

The programme dealt with both the *invisible* exchange of information amongst scientists and the *visible* chain in scientific communications — right from the access, storage and retrieval of scientific information to its dissemination and publishing.

The challenge to managers, officers, and users of information services was highlighted and discussed.

Thème

Avec les années 1990, nous entrons dans un décennie de transformations affectant les relations internationales, les communautés économiques, les structures politiques, les zones linguistiques et les technologies avancées. On assiste à l'effondrement d'anciennes barrières.

Le programme s'est interessé aussi bien aux échanges *invisibles* d'information entre scientifiques qu'à la chaine *visible* de la communication, depuis l'accès, le stockage et la recherche d'information jusqu'à la diffusion et l'édition.

Le défi posé aux administrateurs et gestionnaires tout comme aux utilisateurs de l'information a été mis en lumière et discuté.

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TECHNICAL EVALUATION REPORT

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INTRODUCTION

This evaluation report is intended to be read without necessarily referring to the published papers that follow. It is in two parts. The first reviews the papers themselves, with emphasis where possible on the oral presentations and ensuing discussion. The second part groups the emerging themes, makes comments, raises questions, and recommends possible actions. The views expressed are those of the reviewer alone and do not reflect the policies or positions of his organisation or of AGARD.

PART 1: PAPERS AND DISCUSSION

KEYNOTE ADDRESS

The changing social scene, far broader than the current political changes in Eastern Europe, was described by Mr. Møller, who challenged us to adopt new attitudes and develop new institutions to face the societal changes beginning to take place.

History has been determined by the interaction of technology and culture: the more complex the technology, the more complex the society and the greater the need for information transfer. Industrial society has been dominated by centralisation, large units, vested interests and conformity, but it also produced the welfare state. The information society fosters decentralisation and individualism, breaks down traditional class distinctions, alters work habits, requires rapid change, and will probably produce clashes of culture.

The industrial world's socio-economic system will be replaced by a society depending heavily on human capital. Investment in machinery and management of physical resources at lowest cost will be replaced by management of people and investment in their development. The information society based on human resources will be challenged to preserve dignity and to recognize individuals for more than what they do. Technical competence in management must then be accompanied by cultural knowledge, essential for dealing with staff in many countries. The 'rich' will be those who can adapt; the 'poor' will be those who cling to industrial society concepts.

The checks and balances of business and unions upon each other will no longer be appropriate. With jobs disappearing permanently, unemployment insurance will lose its main aim of preserving the labour force for the next economic upswing; it must be replaced by training if it is not to keep people outside of society.

Part-time work and 'tele-working' will encourage a society in which the trend setters will be retirees with purchasing power, demanding active leisure and continuous adult education packaged at leisure centres. The leisure society, however, will have less need for concentrated services, such as rush-hour transport, and individuals will refuse to pay for services they do not use. Such public services, the past counterpart of growth, will no longer be appropriate. Welfare, now a public sector function, will be provided by the revived multi-generation family, recognised as a pillar of society.

In the next decade Mr. Møller foresaw grand social engineering, the like of which has not been seen for two centuries.

PAPER 1

Dr. Shea outlined a new role for NATO as a source of European stability, but not as the world's sole peace keeper. Today's strategic environment is essentially the reverse of the one which gave birth to NATO. Two zones of high tension but also of high stability, in which NATO adopted a defensive, passive posture, have been replaced by a stable Western zone and a very unstable Eastern zone. Without an overall (Communist) control, the mismatch between 'national' boundaries and ethnic and religious divisions has led to a proliferation of states in conflict. At the same time, the economic slump has prevented the generation of resources that would help unstable countries. The current glut in weaponry, aggravated by Russia's need for hard currency and the West's desire to keep its arms firms in business, now enables a country to be a world-class military power without being first a world-class economic power. Refugees will become a major problem for the EEC.

These conflict-causing factors will give rise to both preventable and unpreventable wars. Wars of interest, in which our economic or military security is threatened, will see NATO action, but being preventable should not be the trend. Wars of conscience, on the other hand, will not be preventable, Yugoslavia being a prime example. Hesitation and controversy within NATO will cloud objectives and make military means difficult to define. Currently, Europe has no formula for dealing with crisis and lacks clear strategic objectives. NATO has strength but no mandate; other international bodies have no forces; none has complete ability to act. A re-definition of peace-keeping is needed, with NATO learning to act under UN direction, with other bodies joining in, and with UN rules changed so as not to

jeopardise peace-keeping actions. In Dr. Shea's opinion, with an adequate early warning system peace could be kept by only 7 highly trained professional divisions, using fast-reacting, helicopter-based transport, with pre-positioning of supplies, and provided with high technology for reconnaissance, intelligence and communications. But the political will must be there.

PAPER 2

Called upon at short notice, Prof. Tjell enlarged upon a recent OECD seminar paper based upon experiences at the Technical University of Denmark in co-operative projects to aid Eastern European universities. Results so far have been meagre and disappointing. Reasons include traditional differences of emphasis; for example, Soviet universities were primarily teaching establishments, most research being done in the 250 institutions of the Soviet Academy. Also, rapid social change has been accompanied by inflation, 'brain drain' and lost markets, diminishing the economic activity that would have assisted university development. In Lithuania, for example, the one former academy is being dismantled for lack of funds; the two technical universities seek collaboration with the West, but have few contacts and have lost many professional staff. The poor contacts are exacerbated by telecommunications that depend on low technology and are still channelled through Moscow.

The constraints, not confined to one side, include overly high expectations, inadequate resources and infrastructure, heavy and time-consuming bureaucracy, and little academic recognition for cooperative activities. Nevertheless, Eastern European universities are enthusiastic about cooperation and possess a high level of scientific knowledge, from which the West could learn. But working conditions in them must be improved to discourage the 'brain drain'; training in the West is an easy form of aid but only aggravates the problem if it is the only aid given. As returns will be slow, the West should work through many small, long-term projects supported by the public sector.

PAPER 3

Mr. Bonet looked beyond European boundaries. We are now seeing not only the break-up of the former East-West duality, but also the emergence of large, still shifting, economic blocs in competition with each other. Their moves towards internal integration and their interactions are complex and asymmetric because of differing economic power, social structures, and cultures. Europe is facing the problem of preserving member states' cultural identities during integration. The proposed North American Free Trade Area (NAFTA) is still a weakly based bloc of unpredictable future, embracing economic and social disparities and the Canadian constitutional question. Japan is heavily protectionist. The European Community and NAFTA may be steps in further Western integration to counter the East. GATT has forced more interdependence, but renewed calls for protectionism to counter low foreign labour costs show that the right balance with freer trade has not yet been found.

High technology, especially information technology, can promote the dispersion of production and distribution, is key to competitiveness, and has contributed greatly to the relative prominence of the service sector in the overall economy. Increased investment in technology and in research and development is necessary. Economic protectionism between blocs will probably not be great as there will be appropriate inter-bloc agreements. Some protection of cultural activities may be necessary as they become more centralized through migration and the general lowering of barriers. Such cultural protection may also come through technology, such as machine translation aided by human revision, and through electronic media, which, when adequate European standards are developed, should support linguistic diversity, while still reaping the benefits of a single language 'market'.

PAPER 4

Moving from the more general view, Mrs. Czarnota focused on problems of scientific and technical information exchange, using as an example the European Community and the extension of the "acquis communautaire" (body of community law) to the European Economic Area. The protection of information, through patents, copyright, trademarks and similar means, is receiving much attention nationally and internationally. It is an essential component of agreements with former Eastern bloc countries, if technology transfer and financial investment are to take place. In WIPO and GATT forums, the Community's position is to strengthen protection for the creators and distributors of information. Within the Community, a major objective is an information market in which information will flow freely. National barriers remain; European norms, in some cases mandatory, are necessary, especially in the area of telecommunications. New technologies will force some of the issues by creating new types of information and new ways of handling and disseminating it. For example, machine language translation without human intervention is raising new questions of ownership of translation rights. The electronic merging of information from remote sources will require new thinking on value, access and price. The objectives of the Community remain constant in the face of such changes - widening of the range and sources of information available and generous re-use of information for the benefit of society.

PAPER 5

Complementing the European slant of the previous paper, Ms. Tolzman described US networks and associated technology in a non-technical fashion, providing useful lists of networks and electronic journals, plus a bibliography. On the basis of a literature review, she presented some of the issues arising from the phenomenal development of high-

speed international networks. Internet, which began with the late 1960s ARPANET comprising 4 small networks, has grown into the current NET, the collective term for the 10,000 networks currently interconnecting nearly a million host computers worldwide. The tremendous increase in networking speed and connectivity has been matched in machine performance and availability, stimulated by the US High Performance Computing Act and High Performance Computing and Communications Program. The latter also supports the development of advanced software, which currently lags behind the hardware. Such new technology will greatly affect scientific communication, though its nature and timing are debateable and the subject of numerous projects. In particular, informal communication among scientists is being greatly facilitated by electronic mail, bulletin boards and discussion groups, backed by remote access to library catalogues and other information stores. As for formal communication, the electronic journal raises issues of peer review and responsibility for archiving, and highlights the need to indicate the quality of the information on the NET. The speed with which the paradigm of scientific communication will shift will be influenced not only by financial, technical, politico-social and legal concerns but by trust in members of the invisible college and by challenges to the current role of libraries and commercial publishers.

PAPER 6

Dr. Hansen gave a practical example of the problems of networking disparate databases. The IANI interface project was stimulated by the under-utilization of Nordic databases attributed to their variety of languages, database structures, search languages and log-in procedures, and sometimes inadequate documentation. The aim was to offer access through a single log-in procedure and command language, and to stimulate the use of standards. A prototype interface based upon an IBM-AT was demonstrated after only 15 months, but it was 4 years before a marketable product based on UNIX and a SUN workstation was available. It is very expensive to develop and maintain, however, because of continual changes in database structures and hosts' log-in procedures. Library catalogues and non-commercial hosts are much more troublesome in this regard than the commercial hosts, which tend to be stable. OSI standards should alleviate the situation. CD-ROMs, with comparable problems of diversity, are seen as only a partial alternative.

Though the need for a cheap, simple, stable interface giving uniform access to many databases has still not been met, the IANI project has demonstrated it is feasible to logically integrate databases distributed all over the world, and that efforts to achieve this goal are worthwhile. Such projects will eventually enable scientists in Eastern Europe and the Third World to share in and contribute to global knowledge.

PAPER 8

In another Nordic example, Ms. Lamvik described the trend towards end users in Nordic countries after 25 years of database experience. Large numbers of databases, differing in type, structure, language, host and command language, are becoming widely accessible through international networks, complicating the user's ability to select the right ones and use them. Standardisation is more important than ever. Database producers and hosts are using better products and search tools to attract novice and trained users alike. The downloading of search results via networks into PCs can now be followed by the electronic ordering of documents. In contrast to finding and ordering it, delivering information still often depends on paper, but here also electronic methods are appearing, as in the NORDINFO trial of the ARIEL workstation.

Cheap networking has put vast quantities of information at users' disposal. Whether end users search as efficiently and effectively as intermediaries seems to depend upon the type of database, its structure and its quality. However, many end users do not know what information is available, how to find it or how to use it. Hence, intermediaries are still the preferred source of information, if any, for the small and medium size enterprises dominating Norwegian industry. Training, experience and confidence are viewed highly by these enterprises, which are the subject of a project to encourage end use.

PAPER 9

Prof. Topsøe used the Euromath project of the European Mathematical Trust to describe the problems of creating a shared, enriched computing environment as the basis for collaboration and community feeling. Euromath comprises a human network and a central software tool linked by modern communications technology. User communities have so far hardly used the potential of information technology in producing, exchanging and retrieving scientific documents and information. Initiatives to improve the situation must therefore first be user-driven. Dispersed users require a central body to represent them. To assist continued development, user communities should organize user support centres in contact with every user, working in their language, and tracking their needs and problems. The ideal user platform requires a common user interface across applications and a common data model. Structured documents and other forms of standardisation should be emphasised. Euromath is attempting to foster the required conditions for the mathematics community, not only in Western Europe but also in Central and Eastern Europe, where mathematics was relatively strong under Communism. Launching Euromath activities there will require attention to the less advanced computing and networking infrastructure, not forgetting the possibility of jumping straight to today's advanced technology, such as LANs and X-terminals. But progress is hampered by lack of resources and too high expectations.

PAPER 10

Ms. Morris returned to some of the themes of the keynote address, in describing the tremendous pressure for change in the information profession. End users of scientific and technical information services, like users of public services, are becoming more demanding. Technology is making obsolete the traditional approaches of libraries and information centres, which may be bypassed as user-friendly systems make original information sources directly accessible. The current socio-economic climate emphasises competitiveness, downsizing, and value for money. Consequently, libraries are seeing a shift from acquisitions to document delivery, from 'just in case' collections to 'just in time' services. Collections are being rationalised into a few centres of excellence. Information centres are having to concentrate on core services or 'unique selling points' identified, developed, and charged for on the basis of client and competition surveys. Charges must be set in the full knowledge of both true costs and unit costs per client, and should be embodied in a business plan. Restructuring of parent organisations can afford an opportunity for the information unit to show leadership. Above all, in an environment of rapid change, good management of staff and self and a readiness to develop and adapt are essential. The paper included a useful bibliography of selected readings in management.

PAPER 11

Finally, Ms. Carroll reviewed the changing information picture in a detailed paper with statistics and a bibliography, useful to planners of information services. Two recent US studies had identified a paradigm shift in scientific and technical information. Its root causes included: changes in the nature of science, which has become more political; increasing commercialisation of science and a more urgent time-scale; advances in technology, shifting from the print medium to the electronic with consequent blurring of the traditional boundaries between production, storage, organisation and access control; growth in the quantity of information available, especially from 'big science'; and lack of co-ordinated government policy or leadership. Many such factors are not new, and recall the 1963 Weinberg report, which among other things recommended that scientists should take an active role in information evaluation. The resulting specialised information analysis centres were prevented by the reward system of the day from attracting competent people who could inspire users' confidence. Information evaluation is expensive and its benefits are poorly understood. Modern information technology, such as artificial intelligence, may eventually provide a partial solution to this problem, provided scientific criteria ensure database quality.

Statistics indicate the current and potential benefits of information activities. Trends are somewhat contradictory, showing the complexity of change factors. While scientific productivity correlates positively with use of scientific and technical information and while reading of print is increasing in absolute terms, the amount of reading per researcher or per research dollar is decreasing. The increasing number, size and use of electronic databases suggest that reading may be more targeted. Another reason may be changes in inter-personal communications due to the rapid spread of information technology and networks.

The paper reviews the national scientific and technical communication strategies of the USA, Germany and Japan. Although their mechanisms vary, all three countries recognise the importance of scientific and technical information, changes in the conduct of scientific research, the internationalisation of scientific information, and the need for government intervention.

Ms. Carroll identified a principal cause of the paradigm shift as the freedom from time constraints experienced by researchers who adopt information technology. This should be an important factor in planning change.

PART 2: COMMENTARY

The meeting's scope was much broader than the changing international relations of its title. Aerospace and defence information (excluding military intelligence) being a subset of scientific and technical information (STI), the same discussion, except for paper 1, could have been held under many other auspices. Although recent political changes were not expected to be matched in so revolutionary a fashion in other areas, the information profession is in a state of flux because of the economic, political, social and technological changes of the past decade.

The effects of these changes will be both surprising and fast, but generally a gradual evolution was expected, with revolutions in thinking even having to await the next generation of information specialists. Many of the issues raised were not new. Indeed, some first tackled in the early 1960s are still with us, though somewhat changed by technology. Suggested outcomes were still somewhat speculative. It is difficult to predict change; it is more difficult to predict when it will take place.

Security

As paper 1 demonstrated, the collapse of the USSR removed NATO's original raison d'être, but the world is certainly no safer and may even be a more dangerous place. A new role for NATO was beyond the scope of the meeting, but it is reasonable to expect NATO to continue. What therefore should be the new role of AGARD and AGARD-TIP? AGARD's founder, Dr. von Kármán, believed in international co-operation as a means of preventing conflict. Better information exchange might have helped avoid some misunderstandings of the cold war. The new world order will offer plenty of scope for co-operation in aerospace and defence research and development, for peace-making and peace-keeping as well as for civil applications. Science and technology have become internationalised; and, as recognised by some national science and information policies, the benefits of

exchanging information will continue. AGARD-TIP need not therefore consider a major change of programme. Its roles of promoting information exchange among its member countries and of supporting the work of AGARD's other panels remain unaltered. If NATO's policies permit, the Panel could invite Central and Eastern European observers to appropriate meetings, and later develop assistance projects for selected countries, as it has for three countries on NATO's southern flank. Lecture series it has sponsored in the past could be particularly useful.

Problems of co-operation

The problems of co-operating with institutions in former Eastern bloc countries were discussed largely from the point of view of assisting them, rather than receiving information from them, though the latter aspect is not negligible. Co-operation with the new countries of Europe carries benefits to both sides and need not be completely altruistic. However, experience shows that progress will inevitably be slow, not least because it is difficult for us in the West to appreciate all the difficulties. Several infrastructure problems were given as examples - lack of a packet-switched network, routing still via Moscow, low technology preventing overnight telefacsimile transmission, and ignorance of international standards. There are also the non-technical problems of residual Communist attitudes to work and problem solving, the generally poor economic situation, the lack of foreign exchange, and the 'brain drain' attractions of the West. Co-operation must therefore aim at improving the working situation inside Eastern European institutions, a reality also in aid to the Third World. For Eastern Europe it may seem relatively easy to provide modern technology but it must be standard, maintainable and user-friendly. To ensure this, some speakers recommended avoiding the previous generation of hardware and software, despite its cheapness and availability, and jumping to the latest technology now that high power and high reliability can be combined with portability and cheapness (at least for the donor). Adequate documentation and training must accompany the technology.

Language, referred to in connection with the EEC, was not mentioned as a problem in co-operating with Eastern Europe. A common working language, presumably English, must have been found in some of the cooperative projects described. If co-operation is to be broadened, however, it should not be assumed that any Western European language will be adequate for satisfactory two-way communication with scientists and technologist who are not used to international contacts. For the exchange of documented information there must be scope for machine translation, possibly under the auspices of the EEC, one of the leaders in this field.

Socio-economic Factors

The social changes of the keynote address will affect the provision and control of information, and hence the operation of libraries and information centres. Already there have been major reductions in defence spending, attributable more to the difficult economic situation in many NATO member countries than to the 'peace dividend'. Many participants came from defence and aerospace information centres facing drastic budget cuts, staff reductions, and elimination of services. This is symptomatic of the profession, libraries and information centres generally being one of the first parts of an organisation to be affected in hard times. Librarians and information managers have much to do to educate senior management, politicians and government decision-makers in both the costs and the benefits of STI. As many of us know, this is easier said than done. AGARD-TIP could assist its members by collecting case studies.

Right-wing economics of deficit control, tax reduction and cut-backs in public services have forced library and information centre managers to consider novel (to them) concepts, such as charging for services traditionally provided free, full cost recovery, concentration on core revenue-generating services, and business planning. Such concepts require a knowledge of the true, full costs of information acquisition and handling, something that many librarians have never considered before. For the tight management demanded nowadays, this knowledge is essential even if the full costs are not recoverable. Although there was some reference to costs, the meeting provided no practical examples likely to assist those facing this issue for the first time. There is scope here for exchanging costing models appropriate to the economic situation. In connection with aerospace and defence information centres, AGARD-TIP should consider costing models as a topic for a review or lecture series.

One new concept for librarians is that instead of being a public good, information has become a commodity subject to market forces. This may have a deleterious effect in emphasising profits, marketability and quantity at the expense of quality and value, and in providing only the information requested rather than what is needed. This shift in emphasis from those in need of information services to those who can afford to pay for them has already occurred in some countries, and will be spread by international competition. The user-pay principle applied to document delivery, for example, could put much information beyond the reach of poorer enterprises, including Eastern European institutions, an issue that must be addressed in any co-operative information project. External funding may provide documents during the project, but what happens when it is over?

It is noteworthy that the three national information policies reviewed in paper 11 - those of USA, Germany, and Japan - all treat scientific and technical information as having a large component of public good. Though different in their overall attitude to market economics, all three countries are interventionist to some extent with respect to information activities - and are all competing successfully in world markets! For STI a case can be made for strong government support for a variety of reasons - to make tax-funded research results readily available, to provide a safety net for those who cannot afford to pay, to ensure there are cheap, effective mechanisms for exchanging information, or because it

is recognised that in some scientific areas there is no possibility of profitability. Government support can vary from the direct funding of information centres to building electronic 'highways' to assuming leadership in standards setting.

Information Evaluation

The changes in the nature of scientific research and development described in paper 11 have affected scientists' and engineers' information gathering practices in somewhat contradictory ways. With greater emphasis on short-term competitive research, universities and government organisations as well as the private sector are ready to pay higher prices for information, plus a premium for urgent delivery. On the other hand, competition means a more proprietary attitude to information and less pressure, or even a reluctance, to publish in the open literature. Be that as it may, indicators show that shortage of information is not a problem; rather the reverse, the amount of information available continuing to grow rapidly. Hence, as reiterated during the meeting, researchers need help from an intermediary first in locating what they really need but then in filtering it from the rest.

The need for information evaluation as a distinct activity was recognised 30 years ago and has only increased since then, despite the dwindling of the specialised information analysis centres prescribed at the time. Even today, when libraries and information centres talk of providing information, they often still mean providing the documents most likely to contain it, or even more simply providing documents identified and requested by the client. One of the aims of the specialised information analysis centre was to provide the information itself, selected to match needs and with quality and value noted.

Data evaluation is a major consideration in the compilation of many scientific numeric databases produced by centres of excellence operating in narrowly defined fields, such as organic crystal structures or AIDS. Other databases, especially those associated with space telescopes, remote sensing, the human genome and other 'big science' projects, are simply the storehouses of data generated in amounts and rates orders of magnitude larger than those of the past. Such databases require data evaluation on output. Whether at input or output, evaluation by experts is a most important and useful role that is still poorly recognised. During the meeting there were several pleas for quality evaluations not only of information but also of information services. This is clearly a thorny issue, with the danger of measuring only what is quantifiable, such as revenue, and not true value.

As their name suggests, the specialised information analysis centres of the 1960s operated in highly specialised areas. Perhaps in the changed social environment of 'user pay' combined with the availability of laid-off researchers, this concept could be revisited within a restricted subset of the aerospace or defence subject areas. AGARD-TIP could promote the idea of one or more specialised information analysis centres in subjects of interest to NATO, and could conduct a comparative review of those that do exist.

The Internet, providing rapid data transfer across national boundaries, is magnifying the need for an indication of quality. The vast amounts of data becoming widely accessible to the end user in large numbers of databases have already highlighted the need for powerful search and retrieval software, directories, and directories of directories. These should be accompanied by an indication of the quality criteria applied. The traditional safeguard of peer review is in danger of being bypassed because of the ease with which databases can be compiled, and now because of the advent of the electronic journal and the computer conference. These problems have been recognised for some time, but they are now a practical reality and the need for solutions is urgent. There is also much to be learned about the full exploitation and novel uses of such data. Perhaps these issues will stimulate a return to the Weinberg concepts of information analysis in ways that will provide satisfying careers for trained scientists.

Conclusion

Technology is driving many of the changes in the information profession, partly in response to modern economic and social pressures, but also because it offers the possibility of doing things that used to be impossible, and doing them quickly and cheaply. However, technology can be no more than a partial solution to problems that are essentially human ones. The need for computer literacy has spread beyond the information profession, where it is quite high. Echoing the keynote address, the 'rich' will also be the computer-literate. This meeting, like many others in the field of information exchange, was to do with the breaking down of barriers. We must ensure that others are not erected in their place.

Recommendations

Many issues aired at meetings of this type can be turned into general recommendations offered to anonymous decision-makers with little effect. The following are directed mainly to AGARD and similar international organisations who should try to co-ordinate any actions taken.

- AGARD-TIP should continue in its roles of promoting information exchange among its member countries and of supporting the work of AGARD's other panels.

- AGARD-TIP should explore the possibility of inviting observers from the former Eastern bloc to its meetings and consider their problems in its projects and lecture series.

- Co-operative projects must be designed to improve working conditions at home. In providing high technology, attention must be paid to user-friendliness, documentation, training and maintainability.

- International organisations with large translation programmes should examine the need for translation

into Eastern European languages.

- Senior management, politicians and government decision-makers should be made more aware of the costs and the benefits of STI. AGARD-TIP could assist its members by collecting case studies.

- AGARD-TIP should consider costing models of aerospace and defence information centres as a topic for a review or lecture series.

- Projects to help Eastern European and Third World countries obtain STI more easily should take into account the difficulty of continuing to pay for expensive information.

- Governments should recognise the public good aspect of STI dissemination and exchange and provide support appropriate to their economic philosophies.

- AGARD-TIP should review specialised information analysis centres and promote the idea within NATO.

- Information sources and service hosts should indicate the quality criteria applied to the information they carry.

KEYNOTE ADDRESS

THE INTERACTION BETWEEN TECHNOLOGY AND CULTURE

by

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Technology and culture may be perceived in different ways. In this analysis technology is defined as tools. Tools to be used in production and daily life. Culture is defined as habits governing our daily life with regard to both our participation in the production process and what we do in our leisure.

The whole history of mankind is a result of the interaction between technology and culture. They have determined the course of history. The earlier qualitative jumps in the history of man were following the discovery of new technology and how to apply it. This is the case for the transition from hunters to an agricultural society as well as the transition from agriculture to industry.

New technology triggered off new production methods which could not be accommodated by the existing fabric of society.

A simple technology can be applied by one man. As technology becomes more sophisticated, more manpower is needed, and that leads to the question of organization which is the forerunner of any kind of human society.

The more sophisticated technology, the more elaborate a society. Those two have to fit like a glove. No wonder that the present society is growing more and more complicated as the simple industrial technology is being relieved by a much more sophisticated information technology and biotechnology.

The process is clearly visible because the transformation from the industrial society based upon industrial technology into the information society based upon micro-electronics and biotechnology takes place at the end of the twentieth century. Most of the tensions and upheavals in the industrial nations may be conceived as economic or social, but they are in fact a consequence of the clash from new technology probing its way into society.

The fabric of industrial society was forged to suit the industrial technology. Its prime characteristics are centralization, concentration, big units and a big public sector, monopolicies and powerful pressure groups and organizations. In a philosophical context the industrial society and the welfare state developed into a highly regulated nation with clearly defined rules and norms applicable not only to economic units such as enterprises, but also to the individual citizen. It was a society dominated by conformity. The individual had no real identity unless he belonged to a group or a class.

This model worked very well for many decades. It promoted a phenomenal economic growth. But the problem is that such a society based upon rules and conformity is impervious to changes. But new technology requires changes. Otherwise it cannot be applied properly. What happens in these societies is therefore that new technology provokes a clash with the conventional and traditional wisdom. To a certain extent we have a vicious circle. New technology finds it difficult to overcome these psychological and sociological differences. The production process and the fabric of society tend to freeze and thereby make society even less susceptible to new technology. Economic growth falters and the distribution of the cake takes precedence of how to increase total production and wealth. There are too many vested interests associated with the industrial technology and industrial society to make a rapid transformation into the information society. Those who are going to lose by this transformation can use existing laws and rules to stop the process. The potential winners must on top of the economic and social problems overcome all the legal and formal obstacles passed on to them by people and groups possessing vested interests. That is clearly an uphill struggle.

New technology of the kind we talk of here, which makes a total rupture with existing and well-known technology, breeds a new culture. The interaction between technology and culture forges a new society featuring decentralization and small units. The individual is not any longer an anonymous member of a class or a group, but exposes his own life style and identity, not only in the work place, but primarily by choosing various leisure activities. It is a herald of a forthcoming development where the barriers between work and leisure will gradually be obliterated. One of the tangible signs of this is the growing importance of part-time work done in the home.

The audio-visual sector has replaced paper as the most important instrument for bringing the message of a new cultural pattern across to the large part of the population. The new culture is a leisure culture, an information culture and communication culture, but it is also a culture based upon pictures and symbols. This is brought about by the television. An illustration of this is the introduction of logos by almost any firm, organization or group. A printed name does not appeal to the new generation. They need a symbol which they can associate with something. If successful, such a symbol may grow into a rallying banner for people wishing to express the same attitude with regard to life style and identity. The popularity of the Lacoste mark is one of the best examples of this phenomenon.

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The political theories such as socialism and capitalism are closely associated with the industrial society. They are based upon the idea of ownership of the productive apparatus.

The notion of the productive apparatus is closely related to the industrial technology. Physical capital was fundamental for production of physical goods for investment and consumption. As we move into the information society, physical capital is much less important. It is replaced by human capital.

The role of capital and labour is being reversed with the introduction of the information and communication society. In that society human capital has replaced physical capital as the dominant production factor.

When an industrialist bought an industrial enterprise he primarily purchased the machines. When an entrepreneur buys an advanced technology firm he primarily purchases the knowledge of the firm and its staff while the plant itself is of minimal importance. He can replace the plant, but not the staff.

It makes no sense to base political theories upon the idea of ownership in a society of this kind.

Capitalism and socialism will be replaced, but not by a new political philosophy. They will be replaced by a political system offering management and people will choose managers instead of politicians.

This does not rule out elections to choose between different people to govern, but the choice will be between different management styles and not between different political philosophies.

This development premises the consensus emerging in Western Europe and the United States concerning almost all political questions of importance. It is difficult to find a respectable political party insisting on political philosophies. They are all offering the same menu, but with a little less or a little more of the respective courses.

The political parties cannot any longer base themselves and their programmes upon the idea of big and homogeneous groups composed of members sharing the same main interests. They will have to direct their appeal in other and several directions to attract voters who are increasingly volatile, and those who vote for the same people cast their votes for different and sometimes contradictory reasons. The atomization of societies means the end of political ideologies and the rise to power of the political manager.

The crucial question is whether the information society will give birth to a new class or a new big group comparable in size and influence to first the farmer and afterwards the industrial worker. This will probably not be the case because the members of these groups agreed on one simple policy: A better standard of living measured in money.

That will not be the case in the information society where other factors such as lifestyle, identity, leisure and education will be more important and make it difficult to forge a political majority as it was known during the industrial age.

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The industrial structure will undergo tremendous changes. The share of agriculture in total gross national product has diminished and will continue to do so, albeit at a much slower pace. For most industrial countries the share of the population living in the countryside will be expected to stabilize around 5-10%. The share of manufacturing has fallen to 25% in the United States and will probably continue a downward trend towards 20% in the mid-nineties. The rest of the gross national product will come from the service industry. The transport sector will grow. Financial services will grow. But the real growth sector of the future will be the leisure orientated sector. Here we can expect exponential growth of a phenomenal size. This is the multi-billion business of the future.

The leisure orientated service sector falls into three subsectors.

The first one concerns leisure for retired people, mostly elderly people. They want an active retirement. They have the purchasing power and they do not suffer from ill-health to the same extent as our grandparents. The share of retired people will continue to increase in the next 25 years, and if we add an increased purchasing power it is crystal-clear that they are the pace-setters of the future consumption as the teenagers were in the sixties.

One idea is to create retirement villages in grand style where retired people can live together with all kinds of facilities at hand (medicare, health, recreation, sports, leisure). These retirement villages must be placed in an agreeable climate. The transfer of people will primarily take place from the North of Europe to the South of Europe and from North East Asia (Japan) to South East Asia and more likely Australia.

The second one is composed of the economically active population who gets more and more leisure without really knowing what to do about it. All experience suggests that most people want to be active for a certain period of time regardless of whether they are employed or not. If they get more leisure they will demand more active leisure to fill in the gap in their activities resulting from the lower number of working hours. The trend shows that people ask for some sort of total package. They buy a package holiday or they enter new kinds of leisure centres. They seem less willing to use their own imagination to fill out the increased leisure time. The travel business will not only explode upwards, but move away from simple transport of people from one place to another towards the selling of total leisure at domestic or foreign holiday resorts. (Example: Club Mediterrania). Sports of all kinds and subcultures will flourish, and people will form circles or tribes composed of people with the same taste, life style and identity.

The third one is continuous education which will take up an increasing share of time for the adult population regardless of whether they work or not. We have witnessed this development for several decades with the construction of centres for seminars, courses, etcetera. However, this is only the beginning. All kinds of fancy technologies will be used to build seminar centres which are gradually developing into a blend of training centres and leisure centres. People will not only come to these centres for training and education. They will insist on being offered leisure facilities and recreational activities as well.

With regard to the manufacturing sector itself all indications suggest that European manufacturing industry will go through a drastic and painful restructuring in the next five to ten years.

The number of enterprises will be reduced. Each manufacturing sector will be dominated by five to ten really big enterprises calling the tune. The small and medium-sized enterprises will be the victims of this development. Their numbers will be reduced drastically. On the other hand, we may expect a growing number of small enterprises, but many of them will be of ephemeral nature.

There is one common denominator for all three groups of enterprises. That is the growing internationalism. The opening of markets and the free movement of capital and labour plus the revolution in communication make a national firm an anachronism. This is of course more striking for the big and medium-sized enterprises than for the smaller ones, but even the last group will feel the internationalism.

This means that an enterprise will split its activities to exploit the advantages of geographical location where it is most profitable. The headquarters may be in one nation. Research and development facilities in another. Production facilities allocated to several other nations. This is not a once and for all decision. With increasing frequency the enterprises reconsider their allocation decisions in view of recent changes influencing profits. The transfer of big production units to the Far East for the last 25 years is an example of this. The information technology has made it possible for enterprises to work with such a diversified structure. It is also the information technology which paves the way for another revolution: The network system. This means that large enterprises operate a large number of small divisions which have a much looser connection with the enterprise as such. Instead they try to take advantage of possibilities to enter into joint ventures or other sorts of agreements with other enterprises and firms. The time of the well-defined and clear-cut firm is over, and in the future we will witness a much more fluid, but also a much more flexible structure.

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This is where management comes in because internationalism and development of human resources will be the main issues for managers in the next ten years.

Internationalism poses a problem for the middle-level of management which has the technical skill, but not the cultural knowledge to deal with subsidiaries, partners or competitors in other nations. The top level has no problem. They go abroad and they communicate as easily with foreigners as with their fellow countrymen. In fact, these people are forming what may be termed an international power élite.

But middle-level managers face a tremendous problem. They have been trained to solve a well-defined problem (technical sales or service), but their training has not included communicating with people from another culture. This is exactly what the growing internationalism will require them to do and they will find it very difficult to rise to the challenge.

There is no doubt that the speed of internationalism will be reduced because of this problem.

It will especially be valid for what is termed network arrangements which means that a firm finds suitable partners to produce various products. This can only be done if the firm itself is flexible, not only in a technical sense, but also in communicating with other people and other cultures.

The way to solve this problem is not only training courses to understand foreign cultures, but a much higher degree of posting abroad of middle-level managers.

The other trend concerns the development of human resources.

In the industrial age management was mainly a question of engineering. How to make an assembly line work and how to make it run at the lowest possible cost.

As the technology shifts from industrial technology to information technology so does the art of management.

Management is not any longer a question of engineering. Now it is a question of managing people and their qualities. This is so because the new basic raw material is human skill, intelligence and imagination.

General Motors is an illustration of this point. In recent years, more than 40 billion dollars have been sunk in new engineering and new machinery. Productivity has risen, but not to the extent hoped for. Why? Because General Motors has neglected the human factor. Without a dedicated labour force it does not make much of a difference whether you use old or new machinery.

SAS illustrates the opposite approach. In the beginning of the 1980s management changed the outlook and the philosophy of the airline by sending the whole staff on new training courses. SAS invested in people. They did not buy any new aircraft. They were handsomely rewarded by rising productivity and profits.

The need to develop human resources will be even more important as the decision-making process flattens out. Much of the middle-level will be superfluous or even counter-productive if they are not able to contribute ideas. The new information technology means that they are not any longer necessary to pass on messages from above and to control that these orders are being carried out.

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The public sector was the darling of the industrial community. It was one of the counterweights to the big industrial enterprises. The power structure of the industrial society was based upon the following "bigs": Big industrial enterprises, a big public sector, big and centralized trade unions. These institutions produced the necessary checks and balances and they worked remarkably well for several decades. They kept each other in check and produced a reasonably equitable income distribution.

At the same time the public sector had to grow to provide most of the services which the family could not any longer take upon itself because both husband and wife had to work, and the harmonized working hours in the factory and the office block meant that they went away at the same time.

The productivity sector could not expand without somebody assuming the care of the part of the population unable to look after themselves, and that somebody became the public sector.

This can be phrased in terms of welfare economics by saying that business and the active population could still be better off after having paid (in taxes) to the public sector to take over most of the service functions formally assumed by the family or the village.

Few people have realized or understood how well-designed the system was and how well it worked during most of the twentieth century. In logical terms it is possibly the most efficient, almost clinical, economic and social system the world has ever seen.

But the hinge of the system is centralization, concentration and harmonization which make the public sector the unavoidable counterpart to economic growth.

As soon as these fundamental principles are under pressure, the role of the public sector becomes an anachronism in the sense that there is not any longer the same need for the services it offers.

If people have more leisure and if people start to look after themselves and their families, they are not any longer willing to pay the heavy taxes to finance the public sector offering services which they do not want to use.

We may gradually witness some sort of dichotomy. An increasingly larger part of the population does not wish the public sector to take care of their children, the elderly people and disabled persons. At any rate they do not want to pay the public sector for doing so, especially not if they are asked to pay directly and not by way of the tax system.

This group represents the family pattern of the information society with the revival of the multi-generation family. One of the most interesting tendencies is this revival of the family as one of the pillars of the future society. The multi-generation family can and will assume a large part of the social welfare functions hitherto taken care of by the anonymous social welfare system. They are all more inclined to give their children a higher education, and the children tend to stay longer under the same roof as their parents. This is a sharp contrast to the industrial society where children left home early and without a higher education.

The other part of the population consists of people still attached to the industrial society and its values. They want to keep the social welfare functions working according to established practice. The family tends to be one generation. Children leave home early in their life. Elderly people live for themselves and are taken care of by the system. This group is willing to pay for the services offered by the social welfare system, but prefer to do it over the tax system which means that they do not pay the full costs.

The first group is so to speak being exploited by the second group, and the recent endeavours to introduce the price system in the public sector are brought about by the revolt of the first group against the second group. Superficially it may also be seen as the revolt of the rich against the poor, because the poor need the public sector to offer services for which they are not paid. That may be right to a certain extent. But the reason why some are rich and some are poor is that the rich are on the move towards the information society while the poor are poor because they insist on living in the outdated world of the industrial society.

It is also evident that the information society cannot go on with a social welfare system which is geared to serve a far larger part of the population than actually wish to use these services. In one way or another the social welfare system has to be trimmed or to be cut down to size which will certainly be a painful task, but it can be said with the same certainty that it is an unavoidable task.

The social welfare system will change dramatically. It was originally designed more than one hundred years ago, but the system as we know it today dates back to the 1930s and 1940s. It is the twin of the industrial society. Its main aim is to keep the labour force available for use in the manufacturing industry. That is the raison d'être of the system, and as this raison d'être fades away so does much of the political support for the system as we have known it for many decades.

Just one example to illustrate this point. The idea of unemployment allowance was born to keep the worker fit to re-enter the manufacturing industry when the business cycle started to turn upwards again.

That makes no sense today because we are not witnessing a business cycle, but a total restructuring of industry. Most of the workers who are unemployed cannot expect to be sucked up by the same kind of enterprises because many of these enterprises disappear. Instead they will have to be re-educated and retrained to take up different jobs in different enterprises requiring different skills.

Our old-age pension system is designed to pay for a very simple living standard for approximately ten years' time after you stopped working unless you die. But today people live longer and they have a much more active old age.

Perhaps the most dramatic revolution will be seen in the way we define and classify the notion of work, non-work and leisure.

A continuation of the present rigid classification of these notions will lead to a disaster. Only a small part of the population will work in the way we perceive this notion today. There is not much need for the industrial worker in the information society.

A lot of people will perform activities which today are regarded as non-work. Examples of these activities are care inside the family of young people, disabled persons and old people. In today's society this is done by people employed by the public sector. They have work. When the same tasks are assumed by the family, they should also be regarded as work. For one simple reason: The person in question does exactly the same only his/her classification in the old-fashioned employment statistics differs. The perceptions of work should be that people work if they contribute to the functioning of society regardless of whether they are paid to do it or not.

The same goes for the leisure sector including sports activities where a lot of people offer their skill on a non-remunerative basis. Today they do it in their leisure. In tomorrow's society they will do it as their main contribution to society. We will have to regard such activities as being just as usual for tomorrow's society as the activity of the industrial worker in the plant is for the industrial society.

People want to feel that society needs them and that they are contributing to the smooth functioning of society as a whole. They also need a certain form of dignity which flows from the way people regard and classify each other. In the industrial age these needs were met by working in the plant or in the office block. This will not be the case in the information society. We will have to change the cultural pattern so that what is now regarded as non-work and/or leisure takes over from the conventional type of work. What is important is not necessarily what people do, but how they perceive themselves and how others perceive them.

This is why the pure unemployment allowance is a dead end — economically as well as psychologically. It classifies people as being outside society. They are simply not needed. And they are being paid to keep quiet. The psychological impact of this is that people feel that they are some sort of outcasts with a much lower human value than those who work. The psychological difference of being paid for your work instead of "keeping out of my way" is enormous. One of the ways to introduce new cultural norms might be to change the classical type of unemployment allowances into other re-education schemes or linking the payment to some activities which give people the notion of contributing to something.

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The industrial society and the industrial culture produced four main types of people: The farmer, the worker, the office clerk and the craftsman. The four groups were kept apart from each other with regard to life style, identity and culture. You only needed to take a look at the dress to know the group to which people belonged. Inside the group there was a very large degree of homogeneity. All the individuals behaved in the same way which meant that they gradually lost identity as individuals and became somewhat of a caricature of the officially recognized standard type of their group.

It is no wonder that a culture which praised homegeneity did its best to shape a uniform type of people. In a way the comparison with the ants is not too far-fetched. Each ant is a member of a larger group and performs a well-defined task inside a sophisticated distribution of labour. Almost exactly the same is the case for the four main types of people in the industrial society. More surprisingly, the art during the industrial age has supported and not contradicted this tendency. Suffice to look at the paintings and sculptures from the interwar period.

Now the individual is back in style as the information society removes the raison d'être for the four main groups described above.

There are not many farmers left, and those who till the soil have very little resemblance to the traditional farmer. Many of them are part-time farmers. Others are really big farmers introducing what is termed industrial agriculture.

The industrial worker is not any longer the king of our society. His decline is an inevitable consequence of the falling part of manufacturing industry in total gross national product.

The office clerk is not any longer an office clerk, but an information worker doing something which has little to do with the tasks assigned to the well-known office clerk.

The craftsman has left the picture almost completely. In the first place he was squeezed by industrial technology, and what was left has been hit by the new information technology and biotechnology.

On top of this development comes the reduction of working hours which has given each person more leisure, and with more leisure there is more time available for developing and exercising individual taste.

The less homogeneous tasks in the work place, the fact that many people do all or part of their work in the home, and the increased leisure are all factors which work against few and homogeneous groups of individuals. Instead they favour the individual itself with emphasis on different identity and different life style.

The big groups of people have been replaced by many small groups. It is not any longer the work as such which knits people together. It is the skill they possess and more precisely the knowledge they have acquired and wish to keep up to date. That is one of the most striking factors to unite people in small groups for the next decades. Another factor is people's leisure activities which will gradually take over as the dominant element.

This cultural process can be read from the way people choose their dress. It is quite evident that people have gone away from the uniform dress of the industrial society. They now dress in a fashion which is different from person to person, but serves to underline each person's identity. Each person wants to signal that it is an individual. In the industrial society the dress was the uniform of people doing the same work. The work dictated the dress. This constraint has been removed. In the information society it is identity and leisure activities which determine what kind of dress a person chooses from an enormous range of possibilities. As people want to get together in a grouping or a tribe with analogous attitudes they signal their identity to each other by various methods. One of them is to choose a special logo on their dress. In the industrial age the dress was the same and any wish for individuality was left to small items. In the information society the dress is different and underlines the individuality while small items, such as logos, serve to unite people. In cultural terms this amounts to a total reversal of attitudes.

Industrial technology based upon plants and machinery is out. New technology based upon human resources is on its way in.

The reversal of trends is leading to new social engineering on a grand scale during the next decades.

OVERVIEW OF POLITICAL CHANGES IN THE INTERNATIONAL SCENE

by

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Ladies and Gentlemen,

When the British author Joyce Cary was asked why he had joined the Balkan Wars of 1912, he replied that he had not wanted to miss the experience of war, since he had thought that this would be the last of all wars. Looking at the situation in the Balkans 80 years later, one cannot help but remark with great sadness that Mr. Cary's assumption was excessively optimistic.

True, the Cold War is thankfully over, but the new environment is far less benign than we had hoped. We have overcome the old order, but a new, stable order has not yet been established. The Cold War is behind us, but in the Balkans a hot war is being conducted. We have overcome the political division of Europe, but regrettably our continent is still divided into two distinct halves: one which is secure and moving, even with the occasional setback, towards integration and that which is less secure and prone to ethnic conflicts and disintegration.

Historians who favour the cyclical rather than the linear approach to their subject will be at home in this new Europe. The great themes of the closing years of the 19th century are back: the Balkan powder keg, the Eastern Question and the onslaught of irredentism against externally stabilising but internally weak multi-ethnic states. It seems ironic that half-forgotten names, like Bosnia-Hercegovina, Serbia and Sarajevo, that determined the beginning of the 20th century are also accompanying its end, or that the statesmen of today, should be preoccupied with the same diplomatic dilemmas as Bismarck, Disraeli and Andrassy:

- What are the dangers that regional conflicts pose to our national security?
- Is it less dangerous to appease aggressors than resist them?
- Where should we intervene and how?
- Where do we draw the line between advocating territorial change and upholding the status quo?
- Which principles does our common security require us to uphold, universally and by force, if necessary?

During the Cold War the Western Allies had a clear objective: to deter and, if necessary, defend against attack. To do so successfully, we developed the appropriate military planning and means. Today, fortunately our borders and people are no longer under threat. But as a result, however, the definition of what are one's vital interests has become more complicated. In the case of conflicts taking place beyond our borders and posing no direct threat to our survival, it is more difficult to define clear and realistic political objectives and the most effective means to achieve them.

There can be no doubt that the international community, and the EC and the United States in particular, have so far not been able to find a successful balance between ends and means in their handling of the Yugoslav crisis. Should we therefore conclude that our vision of a new international order is unrealistic? Should we abandon our efforts to build a new security order in Europe? Have all the international organisations failed? Has NATO become irrelevant? Is there any chance for us to be able to prevent and manage crises successfully?

These are valid questions to which we must respond. We must start by recognising that there is no pre-determined pattern of history whereby certain events or geo-political situations are destined to repeat themselves every so often. Only those who do not learn from history are condemned to repeat it. We know that many earlier aggressors could have been halted by a timely display of determination by the international community. So deterrence is still a valid basis of security even after the Cold War. In the world of instant communications, economic interdependence and porous frontiers in which we live today, we can even less than in the past quarantine regional conflicts and go about our business as if they would not affect our daily lives in the least.

Moreover, we have the institutions and instruments that are necessary to secure the peace in Europe. They are already there as the building blocks of a new European and world order. There is no alternative to our Alliance's vision of a European security system based on a dynamnic interaction between the major institutions; the Alliance, the EC, the CSCE, the WEU and increasingly also the United Nations as it plays a more important role in peacemaking in Europe.

The only alternative to such an approach would be if there were a single power willing and able to provide leadership in all the crisis situations we are facing and will face in the future. But the only conceivable candidate for such a role, namely the United States, is clearly unable and unwilling to assume this task, even if its active engagement in world affairs and leadership remain essential.

It is also evident that nations seeking to intervene in a regional crisis require the moral support and mandate of either the UN or the CSCE. It is also vital in sustaining public opinion for the burdens and sacrifices that any intervention may necessitate.

Working through the institutions is also the best formula to

secure burden-sharing. It is important, politically as well as materially, that those who do not participate directly in any action at least contribute in other ways.

Finally, we cannot delegate all tasks to the global security organisation, the UN. It is overburdened and under- funded. Its responsibilities in the Third World are increasing even more than in Europe. So it will look increasingly to regional structures and will discourage them from giving up too early or too easily.

However essential this framework of interlocking institutions seems in theory, critics have nonetheless questioned its ability to function in practice. They fear that this concept focuses too much on the prerogatives of individual institutions: producing at best duplication as each institution hankers for its slice of the action or, at worst, paralysis as each institution tries to ensure its precedence over the others.

A future European security system is not, however, something that will just happen - not without a certain process of trial and error as we search for the best formula. Our concept of interlocking institutions has in this respect only just begun to take shape. It will take time for us to make it function properly. Setbacks are unavoidable. NATO, the most successful Alliance in history, was not created overnight or without some hard negotiation either. I do not draw the conclusion that we should abandon our efforts but rather that we have to redouble them. In particular, we must reinforce the operational links and practical interplay among these institutions. They must become accustomed to working together and more aware of the specific contribution to the common endeavour that each institution can and must make. So NATO will have to play its part in overcoming the obstacles that have hampered the smooth interaction of these institutions.

First, the Alliance will have to establish closer links to the UN. Mr Boutros Ghali in his "Agenda for Peace" and letter to the CSCE, has welcomed the role of regional organisations in upholding UN decisions. At the same time, the habit of cooperation and looking to each other for guidance has yet to be established at the working level. In particular, our Alliance's contingency planning in support of UN peacekeeping operations has to be as closely modelled as possible on likely UN requirements and anticipate UN decisions.

Second, we must continue to support the CSCE. Over the past three years NATO has taken a number of initiatives to give the CSCE not only additional responsibilities but also new institutional means to implement them. Our London and Rome Summit Declarations contained many concrete proposals, for instance the establishment of the Committee of Senior Officials and the Conflict Prevention Centre, which the CSCE has subsequently adopted. We have supported CSCE designating itself as a regional organisation under Chapter VIII of the UN Charter. We have assisted its observer mission to Nagorno-Karabak. Most importantly of all we have now offered our Alliance's resources and expertise in support of CSCE peacekeeping operations. So as the CSCE increases its authority in the field of conflict prevention and the peaceful settlement of disputes, its interaction with NATO is bound to grow.

Third, we are establishing a new relationship with the Western European Union. It is obvious that a strong Atlantic pillar in our Alliance has to be balanced by a strong European pillar. There will be situations in which the United States prefers Europe to take the lead. The Yugoslav crisis has been a case in point. So there is a clear need for an effective WEU that can implement the common foreign and security policy of the EC member nations while at the same time functioning as NATO's European pillar. A strong WEU obviously means a WEU that is closely associated with NATO. To operate meaningfully, it would need to be able to use NATO's assets or NATO's assigned forces in cases where NATO does not choose to act. We have offered our assets to the WEU and such double-assignment or double-hatting does not pose any problem so long as the priority for NATO is clearly maintained.

What, nonetheless, we must avoid, is a situation in which NATO and the WEU are compelled always to act together, as if the one fears losing out to the other. Notions of rivalry cannot fail but undermine both organisations and also severely hamper Western military operations in crisis situations. This is especially true of ground and air operations in areas of tension and conflict where a clear command structure is absolutely essential.

Let me say on this subject how encouraged I was by the French Defence Minister's recent speech in Paris in which he proposed greater French participation in NATO structures. If this can be achieved in practice it will clearly make it easier for NATO to play an important role in crisis management while at the same time enabling our European pillar to operate more effectively through the WEU. So given France's interest in creating the European security and defence identity, I would view closer French participation in our Alliance as logical.

Every institution in Europe is evolving rapidly. We are learning that to be successful we have to work through all of these institutions simultaneously. We have to bring their combined assets to bear on any given problem and not be tied by narrow and largely outmoded perceptions of roles and responsibilities inherited from the time of the Cold War.

The Alliance is absolutely crucial to the establishment of a new security order in Europe. NATO needs the support and cooperation of the other major security institutions, but they need us just as much.

First and foremost NATO has kept the United States and Canada engaged in Europe at a time when the change in the geo-strategic situation and the pull of domestic affairs might make many North Americans advocate withdrawal. It is in the interest of the United States and Canada to remain in Europe and even a more cohesive European Community cannot provide stability without them. In Europe as elsewhere, an active American role and leadership is still needed to fashion the response of the international community to crises and challenges. So it would be a major mistake for Europeans to take the North American commitment for granted or to believe that it can be sustained purely through the mechanisms of economic interdependence. It must have a firm institutional anchor to survive. NATO is the institution that the US and Canada look to as the vehicle for their participation in European security affairs. It also sensitizes Europeans to North American concerns and perspectives.

Second, NATO has contributed enormously to military stability in Europe through its common positions in arms control and confidence-building negotiations. As practically all tactical nuclear weapons have been removed from deployment and conventional weaponry drastically reduced, the potential for major inter-state conflicts has receded. NATO's

role in arms control will not stop with the implementation of the CFE Treaty. Our consultations in the High Level Task Force will help to structure and animate the work of the new CSCE Security Forum.

Third, and most importantly of all, of all existing international organisations NATO remains the only one which can guarantee the security of its member countries against all military threats to their security. This is as true of the more diverse and multi-faceted security risks we face in the post-Cold War as of the monolithic threat from Soviet forces in Central Europe during the Cold War. Those who are in NATO are secure. Those who are not are less secure. This simple fact explains why the Alliance remains strong and cohesive despite the fact that the geo-political context which originally lead to its birth has changed completely. It also explains why so many countries in Central and Eastern Europe have expressed an interest in one day joining the Alliance. Of all existing international organisations NATO is best equipped not only with the necessary military means for the defence of its member countries but also with the politico-military instruments of crisis management.

So we need NATO;

- as an anchor of stability in a Euro-Atlantic security order;
- as the transatlantic link;
- as a community of destiny and action of the Western world;
- as a community that insures us against remaining military risks.

Moreover, with the end of the massive threat posed by the Warsaw Pact and the Soviet Union, NATO has acquired several new roles:

- as an instrument of crisis management in the context of the new international order;
- as the cornerstone of a security community encompassing both East and West;
- as an element of stability in Europe from which the new democracies in Central and Eastern Europe will also benefit;
- eventually, as an instrument to support verification and implementation of arms control;
- as a possible instrument to organise a missile defence in order to protect Europe from the dangers of the proliferation of missile technology.

But like all the other organisations, even our transformed Alliance cannot stand still and be content merely to consolidate the changes of the last three years. We have to continue to transform to deal effectively with a European security environment that also continues to change. There are two areas on which we are currently focusing our efforts.

One is projecting stability to the countries of Central and Eastern Europe and Central Asia.

These countries do not need to become members of NATO to benefit from the security and stability that it provides. I personally believe that the enlargement of the Alliance will come over time; when we are confident that it will be no detriment to NATO's cohesion and that new members are able to meet all their political and military commitments to our Atlantic community in full. Nonetheless, in the immediate future what the states are entitled to expect from us is an assurance that they are not alone in facing risks to their security interests, and that they are full partners in a structure developing assistance and advice on regional security. As the ties between the Alliance and our cooperation partners grow, their security structures, foreign policies and strategic concepts will become the basis of broader cooperation, as they have among the 16 NATO Allies over the past four decades. Our aim must be to create a security fabric in Europe that will be more resistant to crisis and instability.

In order to reach this objective NATO established ten months ago a North Atlantic Cooperation Council where we meet with our cooperation partners. By giving these partners a common security anchor in our Western structures, we have helped to prevent the formation of competing Alliances in Central and Eastern Europe. The North Atlantic Cooperation Council has given the countries of Central and Eastern Europe an instrument for addressing their security concerns and for identifying multilateral solutions. For instance, NATO's High Level Working Group was able to provide the eight states of the former Soviet Union concerned by the CFE Treaty with much technical guidance as well as political support and encouragement. This enabled the eight states to reapportion the equipment entitlement of the former Soviet Union.

The Alliance has supplemented consultations within the NACC by a diverse programme of practical cooperation activities designed to help our partners in areas where we have special competence and expertise. So while the CSCE pursues its efforts to establish a political structure to resolve disputes in Europe, the NACC and its related activities within the Alliance are helping to foster a common strategic and military culture rooted in democratic and cooperative behaviour. This can only make the task of CSCE easier.

The second area where we are rapidly developing a new role for our Alliance is crisis management. We have overcome the old and now obsolete distinction between NATO territory and the so-called out-of-area. It is perfectly obvious that our interests and indeed security responsibilities do not stop at our borders. Thus, we have decided that NATO, with its proven crisis management experience and functioning military structure, can contribute to peacekeeping missions.

Indeed, in the conflict in Bosnia, NATO is supporting, with its ships in the Adriatic, the UN in the surveillance of the embargo set against Serbia and Montenegro. We have offered our support to the United Nations and the CSCE, both for protecting the humanitarian relief efforts and for the monitoring of heavy weapons. Our military authorities have drawn up a comprehensive plan for the monitoring of Bosnian airspace and we would be prepared to place some of our unique command and control assets at the disposal of the United Nations. We are also strongly supporting the efforts of the London Conference to find a political solution. So it is now up to the UN and the CSCE to make use of our offers. Member nations made it clear that they only want to act under a specific mandate from the UN or the CSCE. The UN has fortunately taken the lead in trying to solve the Yugoslav conflict. It must continue to have the responsibility for this crisis and it will receive the necessary support from our Allies.

Looking ahead the Alliance will also be prepared on a case-by-case basis and in accordance with its own procedures, to

support peacekeeping operations under the responsibility of the CSCE, including by making available its resources and expertise. The CSCE Summit in Helsinki in July endorsed this Alliance initiative and role. Now it is up to us to develop a concept for carrying it out. We will have to make use of available experience and expertise in the Alliance on the subject of peacekeeping. The specific requirements of peacekeeping missions will have to be factored into our force planning, crisis management procedures, exercises and contingency planning.

There are, of course, conditions governing NATO's participation in peacekeeping activities. First is the need for the consensus of all Allies in the North Atlantic Council. Second is the need to focus our participation on the CSCE area. There can be no question of NATO playing a global role, although it did help with logistics and matériel during the Gulf crisis in support of the UN. We obviously cannot exclude further initiatives of this kind in the future. Third, for NATO to take action the security interests of its members must be affected even if they are not directly threatened.

Subject to these three conditions, I believe NATO can and should participate in peacekeeping missions. Indeed it would be foolhardy to leave the Alliance on the sidelines and its unique assets under-utilized. All the more so when we are considering major military operations requiring the full range of capabilities, such as larger-scale troop deployments, transport, supplies, communications and close air support. The Alliance as a whole could undertake a peacekeeping operation; we could make available common Allied assets or we could support the participation of individual Allies. At all times the UN or the CSCE will retain overall authority.

Looking towards the longer-term, I personally believe that it makes little sense to restrict NATO's role to peacekeeping in the classic meaning of the term, i.e. when parties to a conflict are exhausted and ready to make peace or observe ceasefires. Before we reach this stage, the international community may well have to intervene to create the conditions for peace. NATO's military structure, transatlantic dimension and consultative mechanisms will, in my opinion, become essential to this type of operation either under a UN or CSCE mandate and overall UN or CSCE authority, or even a combination of the two.

Of course, if we are to offer our assistance to the CSCE or the United Nations, we must ourselves be able to deliver; which means that although we no longer need the major force and readiness levels of the Cold War years, it will still be essential for our member nations to maintain and commit to NATO substantial, professional and well equipped forces. These must be available at short notice and trained for the new types of mission they will face. This is why it is crucial that the Alliance's Rapid Reaction Corps, whose HQ structure was unveiled in Bielefeld ten days ago, is now fleshed out into a fully credible force, able to deploy from its 10 planned divisions at least four at any one time. This corps should not be available only for crisis management purposes along NATO's borders but also for peacekeeping missions in the CSCE even, subject to approval by participating nations. The primary task of our forces will be not to fight wars until military victory is achieved but to protect the peace in complex political situations and according to strictly defined political guidelines and objectives. Our forces must, moreover, be trained and equipped to work alongside a number of international and civilian organisations. "Protect, help, save" must be the soldier's motto in the future, particulary with regard to the peacekeeping, peace enforcement and humanitarian relief operations that, I fear, will be with us for some time yet to come.

So my conclusion is clear. NATO must continue boldly on its new course of projecting stability into Central and Eastern Europe and participating in crisis management. To the extent that we do this it will also be easier for us to develop the institutional links and close interaction with the other security organisations. We need to be able to deal with specific immediate crises as well as to build long-term stability in Europe through the fostering of a common democratic culture and common standards of international behaviour among all CSCE nations. What we have to aim for is a coherent and, above all, pragmatic approach that enables us, in any given situation, to choose which package of measures and institutions is best suited for our needs. This means that in certain circumstances one particular institution will play the leading role while, in others, another will do so; in still others, joint leadership on the part of two or more institutions may be necessary or desirable. What we must do is keep all our options open and realise that each situation will be different and require a different response.

The American poet Robert Frost once said that "freedom consists in being bold". In a similar vein I would say that peace cannot be maintained without our being prepared to take risks occasionally. We have seen for instance in the case of Yugoslavia that any type of action, even in support of purely humanitarian operations, carries its price. There are no magical solutions to end the bloodshed and reconcile the belligerents. A system of interlocking institutions, even if it can be perfected, will not be a panacea that moves automatically to prevent and manage crises. It will only work if there is determination, political will and leadership from the leading members of the international community.

What we must not do is allow risks to become an excuse for inaction, as if the choice in dealing with regional conflicts were between total abstention or total involvement. For this is precisely the false dilemma that aggressors will always seek to exploit once they perceive that the international community is not prepared to use force. Attempts to deter or repel aggression peacefully, through diplomatic and economic measures, are unlikely to be successful if the ultimate sanction of enforcement under Article 42 of the UN Charter is perceived as bluff.

Yugoslavia has been a sobering experience for those who had hoped that communism would collapse without convulsions, and that Western democratic and liberal values would not only inspire change but also prove sufficiently powerful to sustain the populations of these countries through the problems of transition ahead. But I remain optimistic. We are learning the lessons of the Yugoslav crisis and we are reinforcing the institutional structures that will prevent this type of tragedy becoming the norm in the Europe of the 21st century. We realise today that we still have to secure and protect the peace even after the Cold War is over. We recognise too that we can only do this by preserving a strong and cohesive Atlantic Alliance. Out of this recognition will, I am sure, come the necessary determination to meet the challenges of the future.

HOW TO FACILITATE COOPERATION BETWEEN THE TECHNICAL UNIVERSITY OF DENMARK (DTH) AND EASTERN EUROPEAN UNIVERSITIES (EEU)

by

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Summary
The new situation in Eastern Europe has improved opportunities for cooperation between Eastern European universities (EEU) and universities in OECD-countries. This paper gives a short description of why we at The Technical University of Denmark (DTH) have involved ourselves in activities of this kind. How the new opportunities have been utilized was examined through an internal enquiry, which showed a rather modest involvement in EEU-projects. The experience we have gained from this seems to indicate insufficient financial support, excessive administrative work load, lack of possibilities for professional merit, and language and cultural differences as the four main obstacles for a broader involvement.

As a general conclusion we present the viewpoint that considerable financial resources easy to administer are needed for the development of EEU. As a more concrete remedial action we introduce the idea of regional university seminars as an instrument for promoting more cooperation, proper academic time compensation, and elaborate on other ideas for strengthening the future cooperation with EEU.

The motivation for cooperation with EEU
Many factors and circumstances suggest increased cooperation with the EEU.

Nearly every contact persons from EEU have clearly indicated a deep desire and a willingness to learn about Western university practises with the intention of adopting ideas and knowledge with relevance for their curricula and research.

The EEU want to implement the basic principles of Western university pedagogics, as they wish to benefit from our experience in planning of education in cooperation with the private sector.

Colleagues from EEU teaching the basic academic skills and having their often excellent academic background are interesting partners for their Western counterparts.

The individual departments within EEU have all good, long respected contacts with their local industries. For this reason there could be many good prospects to Danish industry to support DTH-departments in developing their partnership with EEU-departments.

The new Eastern European countries need a rapid social development in order to avoid social disorder and unrest, which could be destructive to their societies and even be a threat to their Western neighbours.

This demands a development of their social structures, industry and commerce. To speed up this development improved education will give the necessary knowledge. Both education and research at the EEU support the specialists who in the future will develop better cooperation with the Western countries.

All these points imply that DTH as an institution has to enter into an agreement of cooperation with several Eastern European technical universities. The same points have also been broadly accepted by the individual departments within DTH. Several of these have agreed to a more concrete approach to working with EEU.

DTH-projects with EEU since 1990.
In June 1992 a short enquiry was undertaken within DTH to sound out colleagues' solid interest in EEU-projects. The enquiry was followed up by a short call to all the departments that had not replied to the questionnaire. (After conclusion of this paper we have got reports of two more EEU-projects). The investigation has therefore certainly not all the relevant activities included. Still, there is sufficient response to draw draft conclusions.

At the time of writing (July 1992) we have solid information of 17 DTH-projects since 1990 that are working with EEU. Four of these are concluded, nine are running and four at the planning stage.

The projects have involved 35 of DTH's academic staff. This would amount to approx. 85 man-months over the last 2½ years. One planned project alone accounts for 48 man months per year for 4 - 5 years.

Taking a broad view of the situation, with a total of 925 academic staff this only accounts for 0.3% of available time. Although we have not got detailed information about the engagement with Western universities, there is no doubt that the EEU-project is a very tiny part of the international activities at DTH.

Other organizations under the umbrella of DTH are involved in various East European cooperation projects, eg. industrial development in a consultancy role. However, this is not included in this enquiry.

Analysis of questionnaire
a) EEU-projects in DTH placed within activity area:

Research	5
Exchange - academic staff	9
Exchange - students	6

Presented by mr. Keiding at the IMHE-conference, OECD, Paris, September 1992. Also presented by mr. Tjell to AGARD, Copenhagen, October 14, 1992.

Developing curricula	7
Teaching	7
Other*	8

*) transfer of software, starting production, transfer of know how, starting new research, administration of planning data, provision of computers and summer schools.

b) There were many EEU-partners and other collaborators in each project and often several in the same country. They were based in the following countries:

Eastern Europe: Poland (16), Rumania (1), Latvia (3), Lithuania (1), Czechoslovakia (9), CIS (1).

EEC: UK (5), France (5), Germany (3), Greece (1), Holland (2), Italy (1).

Rest of Europe: Finland (2), Sweden (1), Austria (1).

USA: (1)

c) For the 13 running and concluded projects the total budgets broke down as follows:

5 projects less than 99.999 DKK
4 projects costing 100.000 DDK to 1 M.DKK
4 projects over 1 M.DDK
The 4 planned projects have budgets between 300.000 DKK and 10.8 M.DKK.
Financial support has been obtained through Danish as well as international allocations.

d) Individual staff of DTH has its motivation in the following categories:
(Each respondent could tick several possibilities)

Professional interest	16
Chance of extra income	4
Moral obligation	9
Other*	3

*) Danish interests could be adversly affected without such projects, wish to continue established contacts, wish to open new international cooperation.

e) The professional outcome of the projects was said to be:
(Each respondent could tick several possibilities)

New professional contacts	13
Access to new knowledge	4
Interest in being involved	12
Other*	1

*) economic spin off to the respondent's department

f) The academic merits of all the projects were said or expected to be:

Dissertations	*1*
Contributions to monographies	*0*
Qualified professional articles	*2*
Other professional articles	2
Contribution to conferences	6
New textbook material	6
Other articles for publication	7
Patents	*1*
Other*	2

*) establishing new professional network, holding international courses.

The underlined activities carry in general highest weight to an academic carrier. It can be seen that expectations are not high in this respect for active participation in EEU-projects.

g) During our analysis of the effective time use, it was found that administration, planning, travelling, and meetings adversely affected the practical project work. There can be two reasons for this. The first being academic staff not generally greatly skilled in administration. The second is the complex and time robbing nature of applying for special grants from international funds and development programs.

h) One of the conclusions to be drawn from this analysis is that those involved in projects believe that there is somewhat lower benefit from EEU-projects than from similar projects with Western cooperation partners.

i) The most *positive* aspects of the projects were given as:

Renewal of contact with former cooperation partners
Enthusiasm and the technical skills shown by the EEU-partners (2)

Sense of accomplishment.
The satisfaction of giving a helping hand.
The integration of various professional skills.
Valuable professional outcome for all parties.
EEU-partner's interest in Information Technology.
To come in contact with Eastern university environment.
To discover the existing high level of qualifications of the academic staff in the EEU.
The Russian project members were surprisingly much more open to change than is usually experienced among Western colleagues.
Opening the breadth of research possibilities.
The happiness and thankfulness shown by the EEU-partners.

j) The most *negative* aspects of the projects were given as:

Bureaucracy and the lack of support from my department.
Language. Communication problems. Travelling difficulties.
Bureaucracy within the EEU. Language. Communication.
The language and the great amount af EEC-bureaucracy.
The language. Very taxing application procedure.
Lack of understanding in the EEC bureaucracy that EEC participants do Bruxelles a political favour. Lack of professional feed back.
The old system in the east has taken people's enthusiasm and initiative away and maintains a leaden administration.
Administration and meetings.
5 of 20 participants in our arrangement treated it as a "jolly". Hopefully these people could be filtered out in future arrangements.
The most tedious problem with our Russian partners was communication.
Research is forbidden in Tempus.
The insecurity and work load imposed on the department to raise funds for travel and other project preparation.

k) Asked if they would do it again, knowing the problems in the EEU-projects, 2 of the involved persons said "no" with these remarks:
- Too much paperwork. It takes time from the fascinating professional work.
- Too many elements of economic uncertainty and the almost impossibility of making a realistic and valid time schedule.

15 said "yes" with the following comments:
- Moral obligation (5)
- In the Eastern countries it is easier than here to convert theoretical knowledge into practical applications.
- Professionally as well as with personal contacts, it is challenging to work in Eastern Europe.
- The Eastern partners have a severe need for a solution to the specific problem.
- Danish environmental interests at risk if the project is not carried out.
- The professional and international cooperation is inspiring.
- Fascinating people to meet and cooperate with.
- My expectations of the project were in harmony with the results.

l) Asked if they would recommend colleagues to involve themselves in projects with EEU, 3 of the involved persons said "no" with these notes:
- No professional credit to be obtained in this project.
- Too much paperwork and a frustrating distance to the "power" in the Tempus administration. Projects supported by Tempus are a clear cut losing venture for our department and an abuse of the moral motivation of the persons involved.
- Reservation of too many ressources compared with the outcome.

11 said "yes". 2 of them with the following reservations:
- only with the role as professional co-worker and without responsibility for administration.
- only if I am convinced that all EEU-participants' expectations and professional preconditions are acceptable.

Conclusions

The outcome of the enquiry and our general experience from DTH lead us to the following conclusions:

1. Although it is clear that the EEU are the main beneficiaries, it should be borne in mind that the Western partners also can benefit substantially from the cooperation on university level. This is especially true in basic sciences.
2. There are often considerable cultural and language barriers, the effect of which should not be underestimated. This is true not only between the university partners, but also between these and the administration of national and international funds.
3. At the DTH the engagement in cooperation with the EEU must be termed as very modest. The main reason seems to be that cooperation with eastern partners normally results in lower academic credit (and other benefits) than in the case of cooperation with traditional Western partners.
4. Cooperating with the EEU is very time consuming compared with other academic work. This gives absolutely no motivation for academic staff particularly for young scientists who pursue rapid academic careers and look for credit. A long term involvement in EEU-projects therefore calls for both a fair and long lasting share of altruism and some sort of adequate academic compensation.
5. In a situation with general reduction in public appropriations, universities are not able to finance the cooperation with EEU as an additional activity.
6. The various funds for EEU-projects rarely cover the full and real costs neither for preparation nor for the project work itself. This limits the motivation, especially at department level, to participate in this kind of activities. The efficiency of the EEU-cooperation is thus considerably hampered by lack of resources, particularly in the preparation phase.
7. The frequent occurrence of language problems to the EEU staff and sometimes in relation to the EEC administration often deters researchers from the minor language areas in the West.
8. The academic staff has appreciated the possibilities for curriculum development and other educational purposes in the Tempus programme during the last three years. However it has been felt as a serious draw back that research cooperation could not be included in the Tempus programme. Universities without research are not universities!

It is therefore most satisfactory that the EEC has now established a new programme especially for development of research cooperation with EEU- partners.

Ideas for promotion of future cooperation with EEU.

Generally there is a substantial need for more resources to develop the EEU within education as well as research. Such resources are clearly not available in the Eastern countries now or in a foreseable future. This calls for increased Western support or reallocation of available resources to this sometimes neglected sector.

The Western support must be coordinated in order to secure an efficient utilization of resources. The main obstacles to this are waste of time in the allocation procedure, language and communication problems, and lack of social commitment to the cooperation partners.

This calls first of all for a much more efficient coupling of an EEU in need of support and prospective Western cooperating institutions. Such coupling could take the form of an "adoption", in which one EEU cooperates with one particular (or a few) Western institution(s) in all fields (education, research, administration, and management), at department level or institutional level. Such well-founded and long-lasting relationships should receive massive financial support for swift development of the EEU in question.

Additionally we suggest as the most important step to supplement the already existing G 24 secretariat (Phare-coordination unit) the organization of several "University Clearing Seminars" (UCS) within high priority areas eg. environmental protection, resource and energy management, language training, general management, labor protection, market economy, etc. The UCS's are thought to be organized by the G 24 secretariate in the following steps:

a) All the EEU's are asked to suggest priorities (limited number of items) of disciplines in which they want Western university cooperation.

b) The G 24 secretariate prepares a priority list from the suggestions made by the EEU.

c) The priority list is sent to Western universities which are invited to indicate in which area they want to contribute.

d) The secretariat organizes regional seminars (work shops) in which the Eastern and Western partners interested in the same area could meet, discuss subjects of common interest, make personal contacts and decide whether or not to proceed in a more organized cooperation. Clearing is here taking place mainly between Eastern needs and Western resources.

e) Present at the UCS shall be representatives from the relevant international funds, who on the spot can assist the participants in preparing applications.

f) Funds for the UCS must be raised by the secretariate. Each EEU is allowed to send a limited number of sponsored (travel and expenses) delegates. A limited number of representatives from the Western universities participate on similar conditions.

In this way we hope to avoid building up new heavy international administrations. DTH is willing to assist in organizing such a system of UCS.

Other important stimuli for enhancing cooperation to EEU: In order also to stimulate applicants not using the UCS-model, special resources must still be available for the preparation of project applications and the starting procedure (travelling, communication and language support). The G 24 should approve this principle for implementation on a national level.

In connection with larger projects, the managers should be offered a course in project management and administration paid by the granting fund. This should be mandatory to managers from both Western and Eastern universities who are not familiar with Western administrative practice.

Contact persons from EEU-partners must demonstrate resonable language qualifications at project start up. Sponsored language courses should be offered where needed in order to comply with this requirement.

To inspire younger Western university staff members also to involve themselves in EEU-projects we suggest full time compensation for activities in EEU-projects, ie. time spent on EEU-projects will be fully compensated by research time. This will most often mean more resources to the departments involved.

THE IMPACT ON SOCIETY OF THE ECONOMIC INTEGRATION PROCESS

by

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1. Introduction.

The collapse of the Soviet Empire, the integration of Europe, the creation of North America's free-trade zone, and the dramatic growth of Far Eastern economies are altering the balance of power in the world today. The decade of the nineties has opened with the consolidation of three major economic blocks—Western Europe, Japan and North America—blocks that will dominate the world economy. This domination is based on a new balance between economics, security, and an increasingly complex set of interdependencies among countries. This tri-polar structure is asymmetrical, which leaves many unanswered questions concerning the final configuration of forces between Europe, North American and the Far East. The break up of the east-west polarity that has dominated world politics and economics since the end of the Second World War has led to the resurfacing of latent ethnic tensions, such as those being played out in the Balkans, and the resurfacing conflicts between north and south[1].

The decline in the competitiveness of the United States and many European countries is in some way reinforcing the formation of these economic blocks and increasing the pressure to protect national industry and employment. The control of technology and strategic sectors is the key to competitiveness among the different blocks, but the impact of all this economic integration is much more complex, with a large number of cultural and social consequences.

At the same time, economic interdependence through growing trade and tourism, and through changing cultural and information relationships among western countries is affecting the production and consumption of cultural goods and services. Cultural industries and markets are becoming more concentrated at the same time as they are becoming more global. The strategic role of technology, the growing importance of some media moguls, and an oligopolistic system of channels of distribution are changing the nature of cultural goods and services and their systems of production and consumption.

Will western nations lose their cultural identity? What will be the cultural impact of reducing economic barriers? People are beginning to feel that these questions are important for the survival of their traditions and life styles.

2. Towards a New Structure of Economic Blocks in the 90s.

The process of globalization has accelerated since the Second World War. Moreover, this process has been characterized by periodic crises caused by the confrontation of the economic and political interests of a variety of economic actors: governments, transnational groups, influential financial institutions, unions, business associations, and other more localized interests. The huge cultural, ideological, religious, and economic development differences across countries, as well as the necessity for preserving national identity after periods of oppression, have fueled a fear of national dissolution in a world less and less controllable locally (the case, for example, of the former colonies in the third world, the new states of the former Soviet Union, and in the countries of Eastern Europe). This recognition suggests how heterogeneous the local and regional answers to the globalization process will have to be.

These major economic blocks are asymmetrical in that they each exhibit very different characteristics concerning financial power, control of markets, and military and political power, as well as varying degrees of control over certain sectors of technology and the capacity to implement regional and global strategies. This fact produces different levels of political, economic, social and cultural cohesion inside each block, an asymmetry in the new relationship of forces.

Without doubt, Japan possesses the greatest political, economic and cultural cohesion of the three blocks. It is a country without linguistic or cultural minorities and with a very low proportion of non-native population. The values of the Japanese people, even with the shock of the difference between oriental and occidental cultures (particularly strong for the newer generations who are coming more into contact with western cultures), together with very highly disciplined production and forms of distribution that are particular to the Japanese economy, guarantee a strong protection of internal markets and a large capacity for external commercial and financial expansion.

At the other extreme, is Western Europe, a mosaic of cultures and centuries-old traditions in a continent that is in process of transformation. The process of European integration, with all its attendant problems, has been and will continue to be a long one. Yet, it has the advantage of achieving European cohesion through a democratic and peaceful process among nations that historically have been adversaries. The strategy adopted fifty years ago by the forefathers of this new Europe, which started with an economic union, has proven its utility. However, we must not forget that Europe is advancing toward a new configuration of both its socio-political space and of its rules of internal and external relations, without losing much of the uniqueness of each nation and without losing any of their constituent rights or traditions in the process. This explains the current crisis of trust surrounding the Maastricht Treaty as well as why the process of transformation has been slow, full of obstacles and filled with some significant contradictions. It would not be too misleading to suggest that through a new union most Europeans do not want to lose that which has defined them as peoples for more than a thousand years

Turning, finally, to the North American economic block, here the process of integration is very recent and its bases are still very weak. The American melting pot is very different from the links of intercultural relations found in Europe; the majority of Americans left their country of origin to become part of a new country (whether of their own free will or not). The young country developed its own rules and values, recasting them from the rules and values of its peoples' countries of origin.

The recent free trade agreement between Canada and the United States, like the one that is about to go into effect between Mexico, Canada, and the U.S., is, nevertheless, a less well developed form of economic union than the result of thirty-five years of working together towards the creation of the European Community. The large differences between political cultures and the level of development of the economies of these three countries make it hard to foresee how the economic "union" of North America will progress[2]. In addition, the dependency of the two countries at the geographic periphery, Canada and Mexico, on the giant in the middle is very important, though for different reasons.

To the north, Canada, relatively developed economically, is engaged in a debate concerning constitutional reform that could lead to a rupture between the two dominant cultural communities—the francophone in Quebec and the anglophone in the rest of the country. The problem will be how to achieve an acceptable level of political independence while not rupturing important economic interdependencies. This dilemma occurs at two levels: Quebec with respect to the rest of Canada, and Canada with respect to the United States. And it is just as true with cultural forces as it is with political and economic forces.

To the south, Mexico, a state with strong ups and downs that are both social and structural, is fighting to rise out of underdevelopment and not be solely a source of cheap labor but a more open and a growing economy.

Finally, the United States, in spite of its internal cultural diversity, was able to create a homogenous market and a strong and unifying patriotism. As the "winner" of the Cold War, the United States is now trying, in spite of considerable economic uncertainty in the American economy, not to lose its leadership as the richest and most powerful country.

Table 1 summarizes some demographic and economic data on the three blocks and highlights important differences in economic growth and investment. In aggregate terms, the European Economic Union, with 380 million inhabitants if we add the twelve EC countries to the six EFTA countries, is the main economic and commercial power in the world, though when viewed on a per capita basis, GNP per capita is slightly higher than in Japan or the United States. The United States, by itself, is next in terms of overall population and GNP (including Canada and Mexico in a free trade agreement will reach a combined population of 360 million, more than the population of the European Economic Area), but when viewed with respect to the proportion of GNP that is spent on capital investment, the United States is the weakest of the three economic blocks. Finally, Japan, a much smaller country but a country with a much greater capability for autonomous investment, has experienced a growth rate in GNP that is roughly twice that of the other blocks.

3. Economic Effects of the Process of Globalization.

One phenomenon that characterizes the evolution of the economies of the developing countries since the Second World War is the process of growing interdependence, which has had a strong impact on the world economy. In the beginning, fueled by the American economy and later by the growing commercial multilateral relationships thanks to the success of the GATT agreements, the western economies broke loose from pre-war protectionism, and corporations began to organize production and their commercial strategies at a supranational scale.

This process is not always homogeneous because it follows economic and commercial logics that themselves differ from country to country and sector to sector. These logics are the result of differences in political considerations, technical characteristics, the relative costs of labor, transport, and raw materials, and the strategies adopted by various economic agents. In some cases, the consolidation of regional economic integration and the establishment of new free trade areas not only increase intraregional relationships, but

also force the system of production to learn how to compete in these new regional markets, thereby also training them how to compete better in newly-created world markets

Another important phenomenon is the increasing role of the tertiary (service) sector in advanced economies. In 1960 the service sector was 53.7% of the Gross Internal Product of OECD countries; by 1987 this proportion had grown to 63.7%. This change in the production structure is due to three factors: (1) the relative increase in productivity of the industrial sector as compared to the service sector, (2) the exportation of labor intensive industries to third world countries where labor costs are lower, and (3) the increasing importance of information as an input to production and the rapid change in the information requirements of the overall economy, which have, in turn, transformed the basic nature of economies.

During the last decade there has been a growing internationalization of western economies. Corporations have been forced to an increasing exploitation of synergies, economies of scale, and improvements in productivity by the necessity of competing in larger markets. That this was possible was due to the simultaneous development of the transportation, telecommunications, and information sectors of the economy.

Nevertheless, increased competitiveness in some parts of these economies has been accompanied by increased calls for protectionism in other parts of these economies. Strong and growing competition from southeast Asian economies, not only Japan, the invasion of consumption products from developing countries, and the increasingly transnational nature of major corporations, has fueled protectionism movements among the more traditional actors such as unions and among industries whose technologies were relatively mature. They fear that it will be impossible to compete with countries with lower costs and looser labor regulations. Thus, in the developed countries we see two contradictory movements manifesting themselves at the same time—those that support free trade and those that call for increased protectionism.

Ironically, protectionism forces encourage the creation of large economic blocks, within which protectionism gets played out but at a larger scale, protecting labor and industries at the continental level instead of at the national level.

But how will these new economic blocks maintain competitiveness? The control of technology and, more generally, of all the strategic sectors, with all their economic, social, and cultural consequences, will be the key to competition between Europe, North America, and Japan.

4. Technology and World Distribution of Production.

In addition to the internationalization of the world economy and the growing role of the service sector, the need for increased capital investment in technology is fundamental in developed countries. Particularly important in order to be competitive on the international scene is investment in research and development (R&D).

Gains in productivity coming from the application of new technologies include the replacement of labor by capital. In the case of sectors that are not technologically advanced, are non-strategic, or have low transportation costs, it is difficult to compete with imports that come from developing countries. Economies with low or negative growth rates or that are unable to transform their production structures experience increased unemployment.

However, despite the reduction of labor costs in relation to global production costs, the difficulty of obtaining economies of scale in many sectors of activity leads many manufacturing businesses to modify their location criteria from what would otherwise be expected[3]. Businesses may well prefer to decentralize their bases of operation to be closer and more responsive to big markets—North America, Europe, Japan, and some other big countries such as India, Mexico or Brazil—rather than to locate in other developing countries, even those with lower labor costs (but greater political uncertainty).

The rise of protectionism in international markets coming from within the big economic blocks is one of the reasons that businesses have decentralized their operations into the home territory of other blocks, but it is clear that there are many other factors that affect this decision[4]. It is easy to overlook the fact that most direct international investment still goes to the biggest markets in developed countries. For example, in 1987 the expectation of a single European market led to a 24% growth in American investment in Europe (40% of global American external investment in that year) despite the weakness of the dollar and to a 90% growth in Japanese investment in Europe (20% of its external investments)[5].

Investment in new technology is critical to the localization of production. Sometimes, technology promotes economic concentration, but other times it promotes the dispersion and desegregation of production. At a global level, this means a new distribution of production around the world in which investment in research and development is centralized while manufacturing may become increasingly decentralized. It is not surprising that research and development tends to take advantage of the high economies of scale that are characteristic of the kind of production that requires high levels of information input. The informatization of production and the development of communications play a very important role in centralizing research and development activities. Decentralization, on the other hand, is promoted by the increasing flexibility and responsiveness of small units of production that may result in lower transportation, labor, and tax costs.

Both of these contradictory forces are the result of technological change.

5. Concentration and Oligopolization of Markets and of Production: The Case of the Research and Development Sector.

The globalization of markets and of economic relationships implies, as we have already seen, growing competition; but contrary to what one would normally expect, both production and markets in developed countries are becoming more and more oligopolistic. The corporate battle to control large markets, at the continental or global scales, leads to a profusion of mergers, acquisitions, or entrepreneurship agreements. In Europe, for instance, the number of mergers and acquisitions and the degree of vertical and horizontal integration are both increasing very quickly in expectation of the European single market. At the same time, many middle-sized, yet nationally strong, corporations are signing agreements with similar corporations in other countries with the hope that they will be able to protect their national position while expanding their business.

For big corporations the economic integration process has been good, especially in sectors with high barriers to entry and high economies of scale, because they have been able to take advantage of the opportunity to build oligopolistic markets. Mergers and acquisitions are the quickest way to grow; for the largest corporations, the synergy that can be achieved in larger markets makes mergers and acquisitions an even more critical element of their business strategy.

Of course, government and smaller corporations try to discourage this type of market behavior. In the United States as well as in most of the biggest European countries and at the level of the Commission of the European Community, there is anti-cartel legislation controlling mergers and acquisitions to protect both consumers and internal free competition. Nevertheless, government treads a fine line between determining, on the one hand, that a market is being controlled oligopolistically and should be regulated and, on the other, that a national corporation should be allowed and encouraged to expand its market influence so that it can achieve a size sufficient to enable it to compete on a global scale. Achieving the correct balance between these two positions is now as politically controversial in the United States as it is in Europe. The European Parliament has proposed making the European Superior Court responsible for the supervision of mergers and acquisitions; others have proposed a new organization to assume responsibility for all issues related to the protection of competition in the European Community[6].

The corporate need to collaborate in research and development because of its expense and its strategic importance in international competition has led to a loosening of anti-cartel regulation in most developed countries. The 1947 Japanese law on monopolies allowed cartels if they permitted rationalization and economic growth in an industry, but during the 1970s two new laws used fiscal and financial benefits to promote corporate agreements, mergers, or acquisitions to encourage research and development activities. In the United States, the National Cooperative Research Act of 1984 in support of collaborative R+D agreements is the first law to go against the American tradition of anti-cartel legislation. In 1984 to avoid market segmentation the European Commission adopted a law promoting R+D collaboration to help the European high technology sector, which was weaker than the comparable sectors in America and Japan. Programs like BRITE, ESPRIT, EUREKA or RACE are good examples of this new policy.

6. Strategies and Contradictions in the Blocks' Policies.

The processes of regional economic integration in Western Europe and in North America are the response of the most opulent and powerful societies of the planet to the unstoppable process of globalization.

The motives that have accelerated these processes range from the fear of loss of competitiveness and of control over trade and high technology, especially in sectors considered strategic, to the growing inability to control the large transnational corporations. Control over strategic and high technology sectors is becoming a key element among the three blocks competition, especially during the current wave of economic recession and protectionism.

The danger of neo-protectionism among the three blocks is clear, although it probably will not occur to the degree that dominated international commerce during the thirties. In the eighties a number of bilateral conflicts occurred between the different blocks centered in sectors such as aerospace (between Europe and the US), semi-conductors and telecommunications (between US and Japan), or the VCR (between Japan and Europe), to give only a few examples[7]. In any case, in growing markets the need for self- protection will remain basically centered in those considered key sectors[8], or in other sectors with particular characteristics:

a) sectors with high entrance barriers whether economic or temporal,
b) sectors that are generators of surplus value and/or with growing benefits,
c) sectors with strong economies of scale, and
d) sectors with difficult movement of capital.

In these sectors, protectionism would not harm the internal consumer, and therefore, the activity of industry lobbying groups will find a favorable response from government.

On the other hand, when we talk about formulating policies with products of emerging technology, as is

the case with high resolution television, the situation is not so clear because the national interest is often difficult to determine. The situation of the United States, in this case, is not easy, given that the European and Japanese authorities have respectively approved their own standards of HDTV. The presence of important North American companies in the sector dominated by Japanese and Europeans[9], makes it difficult for the Federal Communication Commission to satisfy the greater benefit of its consumers and the business sector at the same time. At the moment, this agency is supervising six standard alternative models, although it looks like a digital system will be chosen. The reason, according to some experts, is that given the quick evolution of research in digital television based on computational technology transmitted through fiber optic cables, it is probably better to ignore HDTV and invest in a field where the US has a comparative advantage[10].

One of the most serious problems of economic relationship among blocks is its inequality and a ymmetry. If each block had had a similar presence in the others' territories it have been possible to foresee a progressive disappearance of strategic protectionism among the blocks. This is not the situation for the moment, since Japan not only maintains a protected internal market, but also is the strongest country in terms of foreign investment. Nevertheless, because each block has many cross *investments and interests, and* because it is difficult to know where some big corporations are from, the different countries might unify to break their trade barriers and to work together in areas such as Research and Development and the protection of international competition.

I think that European integration, followed by the North American intent to create its own free trade zone, are no more than steps in the economic process of western society's integration. It will require the acceptance of political and economic interdependence, in orther to enjoy the benefits of shared stability and control over certain transnational strategies, as well as lower costs in a much more competitive, more efficient and larger market. This integration process does generate, however, the need to accept limitations in state autonomy.

In the short term, the search for security, immediate benefits and stability, seems to lean towards greater protectionism between blocks, which would be harmful on a global scale. In any case, I don't think that this will go much further than the protection of certain sectors considered strategic for each of the sides, given the large benefits that can be lost in a "balkanization" of commercial international relationships. Many interblock technology investment agreements are becoming more imortant[11], and some continental research fonds, EC programs in particular, are now open to non-European corporations.

7. Cultural Dimension of the Globalization Process.

Economic interdependence evidenced in growing trade, population mobility, tourism, and in new cultural and information relationships, now takes place on a planetary scale and is changing a large number of social, cultural and economic habits. The dimensions of these modifications are different in each society, but the degree of penetration of social and cultural international values, and habits of consumption and production styles is much more intense in western societies. Strong economic development and the existence of a common root culture have facilitated the development of a transnational cultural industry in the powerful mass media with high transnational interests.

Cultural industries and markets are becoming more concentrated at the same time as they are becoming more global. The strategic role of technology, the growing importance of some media moguls (Time-Warner, Bertelsmann, Hachette, etc.), and an oligopolistic system of channels of distribution are changing the nature of cultural goods and services, their markets and their systems of production and consumption.

Table 2 summarizes the acquisition policy of some of the biggest media corporations in the 80s. Most of them bought American audiovisual, publishing or music companies. There are strong economic as well as technological reasons to do this.

Will western nations lose their cultural identity in this market concentration process? What will the cultural impact of reducing economic barriers be? In Europe, people and governments are beginning to feel that these questions are important for the survival of their traditions and life styles.

The impact of the globalization process is not homogeneous among all the countries. Market oligopolization, external dependence, transnationalization of national cultural industries, and the profile of cultural consumption depend from country to country on factors such as:

a) The degree of protection and regulation of cultural markets (national anti-trust legislation, national ownership of mass media, regulation concerning advertising and television, cultural protection policies and grants, etc.)

b) The use of language in the assimilation of transnational culture into different western societies. National cultural goods and services are less represented in their own markets in small anglo-saxon countries than in latin cultural countries. In Canada, for example, American TV shows have much greater audiences in anglophone Canadian provinces than in Quebec[12].

c) The vitality of artistic life, and the level of local cultural business activity.

d) The degree of developement of national technological and informational industries.

Western Societies are proceding toward more homogeneous cultural lives and habits. But, at the same time, they will protect their own national and natural heritage as somethig important for their own social and political survival.

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[1]See, among others, The International Spectator, July-September 1991, Vol. XXVI, n° 3, about International Political Economy in a Tripolar World; or GILL, S. & LAW, D. (1988), The Global Political Economy: Perspectives, Problems and Policie s, Baltimore: The Johns Hopkins University Press.

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[6]PELKMANS, J. (1991), "Towards Economic Union", in LUDLOW, P. (Ed.), *Setting European Community Priorities 1991-92*, London: Centre for European Policy Studies/Brassey's.

[7]MILNER, H. & YOFFIE, D.B. (1989), "Between Free Trade and Protectionism: Strategic Trade Policy and a Theory of Corporate Trade Demands", *International Organization*, n° 43.

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[9]Thomson, Phillips, Matsushita or Sony own some of the most important American companies in this sector.

[10]DUNNETT, P. (1990), *The World Television Industry: An Economic Analysis*, London: Routledge.

[11]JACQUEMIN, A. et al. (1986), *Compétition européenne et coopération entre entreprises en matière de Recherche-Développement*, Luxembourg: Commission des Communautés Européennes.

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Table 1

Economic Comparison between the EC, USA and Japan.

	POPULATION (millions)	GNP 1990 (trillions $)	GNP/cap.'90 (thousands $)	%Δ annual GNP 1960-87	Capital Formation as a % of GNP 1960-87
EC	328.0	6.01	18.3	3.3	21.9
USA	251.4	5.13	20.4	3.2	18.2
JAPAN	123.5	2.94	23.8	6.5	31.4

OECD. 1989 and 1991.

Table 2

Main Mass Media Acquisitions

MAIN GROUP NAME Activity	ORIGINAL COUNTRY	ACQUISITION	ACTIVITY	COUNTRY
BERTELSMANN	Germany	Bantam Books	Publishing	USA
Publishing		RCA/Ariola	Music	USA
		Doubleday	Publishing/Music	USA
FUJISANKEI	Japan	Virgin	Music	U. K.
Communications		Enigma	Audiovisual	U. K.
HACHETTE	France	Diamandis	Periodicals	USA
Publishing		Grolier	Publishing	USA
MATSUSHITA	Japan	MCA Records	Music	USA
Electronic		Universal Studios	Audiovisual	USA
NEWS COPORATION	Australia	Twentieth Cent. Fox	Audiovisual	USA
Press		Ziff-Davis	Periodicals	USA
		Triangle Pub.	Periodicals	USA
		Metromedia	Television	USA
		Harper & Row	Publishing	USA
		Scott Foresman	Publishing	USA
PHILLIPS	Netherlands	Polygram	Music	N.L.
Electronic		Island Records	Music	U. K.
SONY	Japan	CBS Records	Music	USA
Electronic		Columbia Pictures	Audiovisual	USA
		Guber-Petersen	Audiovisual	USA
THORN EMI	U. K.	SBK	Publisher	USA
Electronic		Chrysalis	Music/Services	U. K.

THE EFFECT OF CHANGES IN MARKETS AND TRADE BARRIERS ON THE EXCHANGE OF SCIENTIFIC AND TECHNICAL INFORMATION

by

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The purpose of this paper is to examine the consequences of changes in markets and trade barriers in the exchange of scientific and technical information.

The European Community is a particularly appropriate starting point to examine such a question since as presently constituted it represents a market of over 30 million people brought together in a single market by virtue of the Treaty of Rome.

No doubt at the time of signature of that Treaty by the original members of the Community the same question was asked, namely, how will economic union affect the distribution and circulation of information. No doubt each Member State which has subsequently joined the market has raised the same issue. And it is certainly a question which arises in a particularly vivid form by the non-static nature of the Community itself. Over and above the Internal Market as we currently know it, we have other dimensions which we must take into account.

One of these dimensions is of course that of Maastricht — the question of how far towards closer monetary and political union the Member States are ready to go. The responsibilities will be extended in policy areas such as the environment, consumer protection, health and education. One of the crucial questions is whether all these far reaching advances in policy areas will finally lead to a European identity. Many commentators however now focus on Maastricht as a turning point in the Community's history without understanding the realities of the existing market.

From January 1, 1993, a market will exist which Article 8A paragraph 2 of the Treaty defines as comprising "an area without internal frontiers in which the free movement of goods, persons, services and capital is ensured in accordance with the provisions of this Treaty".

In addition to this single Market in which information, to the extent that it is embodied in goods or services, can flow freely, we must also consider the extension of the boundaries of influence in the Community in three ways. The first way expresses itself in a concrete form by the creation of the European Economic Area. On the assumption that ratification of the agreement by the majority takes place, the geographical area to which the "acquis communautaire" applies will be extended to cover the EFTA countries and corresponding changes to national legislation will occur. As far as future Community initiatives are concerned, the EFTA countries will become partners in a dialogue which will ultimately affect the way in which scientific and technical information is exchanged over a wider geographical area. Some consider the EEA as a transitional phase towards full membership for which they have already applied.

The second, but still tangible form in which the Community may influence ways in which information is disseminated concerns the countries formerly constituting Eastern Europe.

Key areas for the Community here are industrial co-operation, energy, investment, agriculture, the environment and technology transfer.

The Community has already signed association agreements with Poland, Hungary and Czechoslovakia. Other association agreements are under negotiation. These agreements provide for the abolition of trade barriers by the EC, with the Central European countries following suit a few years later. These agreements provide for the raising of levels of protection for information in certain forms within a five year period. This of course highlights a difficult issue. The transfer of technology to countries seeking to develop Western style market economies can only be achieved if companies and individuals which create scientific and technical information are prepared to share that information by investing in the creation and dissemination of information in those countries. In Roumania only 10% of the population have access to a telephone for which there is a ten year waiting list. Problems are fundamental, for example, there is no word in Bulgarian for computer source code and object code. One means to ensure a higher level of investment and increase confidence in the financial return on that investment is to persuade the countries of Eastern Europe to adopt legal regimes and good practices which safeguard the interests of creators and users of information alike.

This brings me to consider what the legal regimes are applicable in the Community to scientific and technical information.

Information requires firstly to be defined. A fact — "the earth is round" — is the property of nobody. Its accuracy may be verified by any one skilled enough to do so and the information that the earth is not flat can be freely disseminated. However not all information is unprotected.

Most scientific and technical information takes on a tangible form. It is text, image, formulae, drawings, electronic fixations of any of these, fixations of sounds, three-dimensional and two-dimensional objects and designs, results of tests and analyses in any of the above forms. The information, in order to have value, must normally be fixed in some form but in theory any information even in spoken form could be subject to protection.

That protection can also take on a variety of forms. Patents protect methods and processes which are innovative, which represent a novel way of making or doing something: copyright and neighbouring rights protect the expression of information in text or numerical form, in computer programs, in databases containing information, in images and designs and in fixations of sounds. Industrial design protection can be used to protect functional and non-functional design both for two-dimensional and three-dimensional objects. The topographies of semi-conductor chips — integrated circuits — are protected. Trademarks and service marks protect names and brands against misappropriation. Of particular relevance to the field of scientific and technical information are the legal regimes on trade secret protection, confidentiality, and unfair competition, and the protection of undisclosed information or know-how.

This brings me to the third way in which the Community has an influence on the question of exchange of scientific and technical information on a world-wide scale. The intellectual property rights such as patents or know-how protection which I have just listed are subject not only to regulation at Community level but also within the context of the World Intellectual Property Organization (WIPO), and also within the GATT Trips (Trade related intellectual property issues) negotiations.

In both these fora, where a hundred or so countries come together to discuss the legal framework in which works embodying scientific and technical information are distributed, the Community position is one of strengthening the protection for those who create and distribute information.

However within the Community itself, great emphasis is laid on the creation of an information market — an area in which information can circulate freely without obstacles created by the existence of divergent national rules. These rules may relate to the intellectual property regimes already mentioned or they may concern other aspects of the dissemination of information. To the extent that national rules on, for example information gathering and transmission remain unharmonized, information flows may be halted at national frontiers in spite of the creation of a single market after 1992. Different restrictions may apply to information providers, technical specifications for information storage and networking may vary, an absence of European systems for information processing and interchange may slow down and discourage the exchange of information between the Member States. Such disharmony is being directly addressed both at a technical and a legal level by the services of the Commission and notably, as far as technical barriers are concerned, by the services of Directorate-General XIII.

One important aspect of the work of the Commission in this area is the creation of European norms — standards by which either voluntarily, or in some cases by mandatory means, certain technical specificiations are laid down. An area of particular relevance is that of telecommunications. Information processing networks can only be established and function efficiently if standard interfaces between parts of the network are created.

Documents may need to be transmitted according to certain standard rules. Facsimile and telephone communication of information is only possible because standard protocols giving access to the network are available. Through European standardization bodies such as CEN and CENELEC, and ETSI, European standards are being drawn up in a variety of fields. This process is voluntary but the results may be made mandatory by application of Community instruments such as the Terminals Equipment Directive, or the High Definition TV standard. Other standards may emerge as a result of pilot programmes carried out with Community funding such as those of the IMPACT Program.

An example of such studies would be the question of a standard format for the digitalized exchange of legal documents or the TEDIS program for the exchange of commercial information, or the TECDOC project which is an image bank for technical information for users in the garage trade. Other areas of Community activity concern the contractual framework for the creation and exchange of scientific and technical information. The Community is a major generator of such information, both directly through the activities of its institutions such as the ESPRIT programmes and other research programmes co-ordinated by DG XII and DG XIII, and indirectly by commissioning work from outside contractors. Often such projects involve many nationalities and result in the creation of valuable scientific and technical information as well as tangible products such as databases or computer programs. In particular the rights in any information so created have to be disposed of in an equitable fashion between the participating entities. To this end the Commission prepared, in May 1992, a joint Declaration by the Council and the Commission on IPR aspects of agreements for scientific and technological co-operation between the Community and third countries. Dissemination of Community research and technology development programmes also calls for action. The Commission recently put out a call for proposals for projects to the value of 500,000 Ecus for the dissemination of results which need not be protected by a variety of means such as publications, seminars, secondment of research workers etc.

Above all the challenge of new technologies creates new types of information and demands new ways to disseminate it. The constraints may be physical — how to store increasingly large volumes of scientific data — they may be legal — who owns information generated in outer space — they may be conceptual — can neural networks be said to "think"?

In real terms these problems are with us today and require solutions. Libraries can no longer stock hard copies in paper form increasing at the rate of ten metres of shelf per day. Satellites are sending back earth observation data to which someone is laying claim because that data can be used to create a variety of derivative products such as maps.

Computer programs already exist which translate texts into foreign languages without the further intervention of a human translator, and create problems of ownership of translation rights. In the not too distant future even more sophisticated products such as neural networks will be available to conduct scientific and technical research and to implement findings in the form of new products. Translation is a problem of particular relevance to the Community. The currently used 9 official languages give a combined total of 72 pairs of translation options. The Community launched the EUROTRA program in 1983. Systran can translate 2000 pages per month. EC terminology databases contain 500,000 terms in use in EC texts. There are more than 1000 translators doing 80,000 pages per month. If 6 further languages were added the number of possible pairs would rise to 210.

Even less "science fiction" scenarios are already posing interesting questions. Open networks make the job of collecting payment for access to and use of information more complicated.

As more information is available by subscription to on-line services, so there are fewer 'sales' of hard copies of information.

Electronic publishing, especially in the multi-media, and electronic database fields, no longer requires that the creation of the store of information and its geographical distribution are closely linked.

Information may be created in the US, merged over a network with information from Japan and be consumed in Portugal. Therefore new methods of controlling access to information must be devised and payment by use methods set up. Values may have to be attributed to certain types of information. The objectives of the Community remain constant in the face of technological change. There must be incentives to create and exchange scientific and technical information. There must be better systems for the storage and dissemination of that information including a simplification and a standardization of the legal and technical barriers which currently exist. Regulation of rights in information and of the collection and distribution of information must be harmonized and strengthened.

There must be a widening of the range and sources of information at our disposal through the funding of scientific and technical programmes and a generous re-use of that information for the good not only of the citizens of Europe but for the benefit of society as a whole.

All views expressed are the personal opinions of the author and do not bind the services of the Commission in any way.

Newly Available Technologies Present Expanding Opportunities for Scientific and Technical Information Exchange

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1 SUMMARY

The potential for expanded communication among researchers, scholars, and students is supported by growth in the capabilities for electronic communication as well as expanding access to various forms of electronic interchange and computing capabilities. Increased possibilities for information exchange, collegial dialogue, collaboration, and access to remote resources exist as high-speed networks, increasingly powerful workstations, and large, multiuser computational facilities are more frequently linked and more commonly available.

Numerous writers speak of the telecommunications revolution and its impact on the development and dissemination of knowledge and learning. One author offers the phrase "scholarly skywriting" to represent a new form of scientific communication that he envisions using electronic networks. In the United States (U.S.), researchers associated with the National Science Foundation (NSF) are exploring "nationwide collaboratories" and "digital collaboration."

Research supported by the U.S. National Aeronautics and Space Administration (NASA) points to a future where workstations with built-in audio, video monitors, and screen-sharing protocols are used to support collaborations with colleagues located throughout the world. Instruments and sensors located worldwide will produce data streams that will be brought together, analyzed, and distributed as new findings. Researchers will have access to machines that can supply domain-specific information in addition to locator and directory assistance. New forms of electronic journals will emerge and provide opportunities for researchers and scientists to exchange information electronically and interactively in a range of structures and formats.

Ultimately, the wide-scale use of these technologies in the dissemination of research results and the stimulation of collegial dialogue will change the way we represent and express our knowledge of the world. A new paradigm will evolve—perhaps a truly worldwide "invisible college."

2 INTRODUCTION

"We expect the revolution in communications to extend the power of our brains. Its ultimate effect will be the transformation and unification of all techniques for the exchange of ideas and information, of culture and learning. It will not only generate new knowledge, but will supply the means for its world-wide dissemination and absorption."

David Sarnoff, 1891–1971
Founder and President, RCA
Wisdom of Sarnoff and the World of RCA

2.1 A recent U.S. National Academy of Sciences (NAS) report addresses perceived impediments to the pervasive and effective use of information technology in scientific research [NAS89]. Included in a series of recommendations, the report emphasizes the user's view in the further development and application of information technology to support the envisioned "global research enterprise." Donald N. Langenberg, chair of the panel that produced the report, writes in its preface "...that information technology is of truly enormous importance to the research community, and hence to all humanity, precisely because it has the potential to enhance communication of information and knowledge within that community by orders of magnitude. We can now only dimly perceive what the consequences of that fact may be. That there is a revolution occurring in the creation and dissemination of information, knowledge, and ultimately, understanding is clear to me. It is also clear to me that it is critically important to maintain our commitment to free and unfettered communication as we explore the uses of information technology in the conduct of research."

In this 1989 NAS report, the effects of information technologies not only in facilitating scientific research but also in changing the way that research is performed are summarized and hypothesized. In claiming that we are on the verge of a revolution through the pervasive use of increasingly intelligent and accessible information technologies, the writers of this report examined three particular aspects of scientific research: data collection and analysis; communication and collaboration; and information storage and retrieval. The writers acknowledge that there is a diversity in research methods among different scientific disciplines and the information technologies needed to support these methods. However, among the scientific disciplines, they find sufficient commonality in these three particular groupings of research activities to warrant and focus their examination of information technologies and their potential for impacting and changing the manner in which research is conducted.

2.2 This paper contains discussions of selected current information technology projects, initiatives, and research areas. Those chosen for discussion are only a sampling of those that have or hold the potential for impacting scientific communication and collaboration, the second of the three aspects addressed in the NAS report. Exciting initiatives aimed primarily at the data collection and analysis aspect of research, such as those in electronic scientific visualization, automatic correlation of data sets, and telepresence or virtual reality applications, will be discussed only in terms of their potential for supporting the collaborative efforts of scientists. Yet, while some of the emerging technologies and projects that will be discussed also can influence the exchange of technical information between engineers and technologists, the focus of this paper will be on communication and dissemination in scientific research.

As has been documented in reports by T. Pinelli [PINELL] and other knowledgeable authorities, the information seeking and use habits, as well as communication habits, of engineers and scientists differ in some important ways.

These differences will not be discussed in this paper. The reader is referred to an issue of *Science & Technology Libraries* (also issued as a monograph) [STEI91], where papers by Pinelli and others examine the information handling differences between scientists and engineers. Additionally, the challenges to communicating through the various languages of the international research community will not be addressed in this paper. This topic deserves substantial treatment and is the subject of a paper by Dr. T. Schneider.

3 TELECOMMUNICATIONS, COMPUTERS, SOFTWARE, DATABASES, AND MULTIMEDIA

The enormous increase throughout the past decade in the availability and power of computational and network resources has provided the basis for a similar increase in the number of scientists and researchers working together without the constraints of geographic distance and time. Facilitated by the use of high-speed networks, increasingly powerful workstations, and multiuser, large computational facilities, collaborative efforts are being undertaken that use distributed and remote data collection devices, advanced analytical and manipulation tools, data and information repositories, and rapid data and idea exchange facilities. With the growing availability and affordability of such capabilities a scientist's "workbench" is envisioned.

3.1 Viewed by many as the world's network of networks, the growth and current size of the Internet is phenomenal. Initially developed as ARPANET in the late 1960s by the U.S. Defense Advanced Research Projects Agency (DARPA), the Internet grew from the four networks connected in the 1960s to 200 interconnected networks by 1985, to 500 interconnected networks in 1989, to the nearly 10,000 networks currently interconnected and collectively referred to as the "NET."

The networks range in size from large international networks with thousands of hosts to small nationally based networks with tens of hosts attached. Table 1 (at right) lists some of the networks and the communities they serve. [CHEN/FOST89 and ALBR/EGRE91] The networks vary not only in size and the communities they serve but also in the access methods and capabilities supported, and the protocols used. However, the use of gateways and routing between the networks is transparent to the user.

Currently the NET connects nearly one million host computers worldwide, where one-third of the host computers are outside the U.S. Recently the number of connected hosts has been growing at the average rate of 15 percent per month. An estimated 10 to 20 million users are serviced through the NET, and this does not include the projected 100,000 U.S. elementary and high schools expected to join the NET in the near future. An estimated 10 terabytes of information monthly moves through just the U.S. national research and education backbone alone. This backbone currently is known as the Interagency Interim National Research and Education Network (IINREN) and can be viewed both as a response to the needs for high-speed interconnected networks as well as an impetus to further networking. NREN has its origin in the High Performance Computing Act signed into law in the U.S. in December 1991. It will build upon and replace Internet whose current backbone transmits at only 45 megabits per second. NREN would transmit at 1.2 gigabits per second. This is the difference between 1,607 text pages per second and 39,000 text pages per second.

3.2 With declining prices for computer hardware and increasing demands for the processing power needed for advanced research, the massively parallel computers known as supercomputers have become more prevalent. Together with the widespread, high-speed connectivity enabled by the NET, remote access to these large-scale machines is available to researchers who can collaborate on research previously not undertaken because of computing constraints. The expansion of this availability and accessibility is a major component of the U.S. High Performance Computing and Communications (HPCC) Program authorized in 1991. [OSTP92]

The performance and availability of machines commonly referred to as mainframes and minicomputers have seen similar growth. Additionally, very large numbers of powerful, increasingly easy-to-use workstations are becoming available to researchers in all disciplines. And the more widely

COUNTRY	ORGANIZATION
Australia	SPEARNET
Austria	ACONET; UNA
Denmark	DENET; DUNET
Europe	EARN; EURONET
Finland	FUNET
France	ARISTOTE; REUNIR
Germany	DFN
Greece	ARIADNE
Iceland	ISNET; SURIS
Indonesia	UNINET
International	CERN; CSNET; E-SPAN; EARN; EUNET; INTERNET; NORDUNET; NSFNET
Ireland	HEANET
Italy	CILEA; CINECA; CNR; CSATA; ENEA; INFNET
Netherlands	ERNET; HRONET; PICA; SURF
New Zealand	SPEARNET
Norway	BIBSYS; UNINETT
Portugal	RIUP
Spain	FAENET; IRIS
Sweden	OSINET; SUNET
Switzerland	CHADNET; SWITCH
Turkey	TUVAKA
UK	JANET
USA	BITNET; INTERNET

Table 1. Selected national and international scientific and academic networks.

available personal computer is becoming steadily more capable. With these increases in processing power come capabilities for machine manipulation of data and information in numerous dimensions and media. This has created many computer-literate people who are growing accustomed to direct access to computing and information resources.

3.3 The performance of the software through which people interact with and instruct computers to operate has advanced but not quite in tandem with computers. Based upon research in computer science, cognitive science, and linguistics, software programs and the processor-controlled machines they direct are becoming increasingly more capable and powerful. Machine intelligence—such as expert systems, voice recognition, speech synthesis, hypertext, imaging, animation, machine vision, simulations, and user interfaces—will be constructed that will enable scientists to navigate through the vast array of data and information resources in standard, intuitive, and consistent ways, collaborate with other scientists, and manipulate and analyze data in ways previously prohibitive in their cost.

The U.S. HPCC Program is supporting software development aimed at the following: higher level languages; advanced compiler technology; optimization and parallelization tools; interoperability support; data management; visualization; debugging and analysis; instrumentation; and performance measurement. These developments, along with the more robust standardized software development procedures and packages, will allow researchers to perform statistical analyses on data, compute complex mathematical functions, simplify mathematical expressions, maintain large databases, and assist in search and retrieval of relevant information. Specialized groupware for collaborative work, as well as other software, increasingly will be user centered.

3.4 Vast machine-readable sources of data and information resources already exist and are expanding with newly released research results as well as the retrospective digital conversion of the rich holdings in libraries and information centers. Additionally, with the development of file format and exchange protocols, the databases of experimental data and analyzed results previously known only to the originating research teams are becoming available for remanipulation and alternate analysis.

New initiatives to create collaboratively and dynamically maintained databases that contain all existing knowledge on a particular subject are being undertaken. These subject-specific electronic databases extend beyond the traditional bibliographic or data distinctions of the past. One example is the Human Genome project at the Johns Hopkins Laboratory for Applied Research in Academic Information. Supporters of this project are working to develop an electronic database that holds all scientific information relating to the genome subject and contains raw genetic data, bibliographic information, and communications from editors around the world who have authority to update the database. The database is kept current by continually adding new information as it becomes available. Researchers in the field can search the database directly and their contributions are or will be posted in an unreviewed section of the database. Following peer review and acceptance, the contributions are transferred to the archival section of the database. The database is accessible through the NET.

3.5 Computer- and communications-intensive, multimedia homogenizes and integrates technologies and media. As the capabilities and availability of powerful computers, greater bandwidth communication channels, enabling software and databases, and auxiliary products are emerging, the much-anticipated era of multimedia likely will become a reality. Multimedia supports the integration of text, graphics, audio, image, and video. Supporting applications such as visualization, animation, and authoring systems for complex documents, multimedia offers tremendous potential for creative and productive exchange of information as well as the generation of new information. The technology also will support hypermedia, a word that encompasses hypertext, hyperlinks, and all other nonsequential navigation and access techniques. Current applications of hypermedia in scientific and technical information are discussed in a recent article by Kaye and Kuhn. [KAYE/KUHN92]

As a visionary of future electronic journals, L. Seiler [SEIL89] postulates on the following scenario using multimedia: "The hypermediated electronic journal article would be accessed from a color display with a resolution equal to that of a glossy magazine. The viewer will read the article or have the computer read it aloud. It could include text, sound, still [pictures], and moving images. Viewers who wanted to read material from a reference could activate their light bar, highlight the reference, and have the computer use a link to the electronic library [to] find and display the full text of the referenced article, movie, soundtrack, personal correspondence, or dataset."

4 SCIENTIFIC COMMUNICATION

Examinations into the communication needs of scholars and projections for changes in forms and processes are not new. [NATI79] Periodically, special task forces and projects are established to examine the productivity of government-funded scientific research. [OTA91, SST92] Inevitably these examinations include a review of communication needs, methods, and forms. However, with the emergence of the integration of capabilities discussed above not only is the U.S. government, including the Congress, looking into the productivity of scientific research, but also numerous independent projects and organizations are emerging to examine ways to facilitate researchers' application of newly available technologies. Below is a brief sampling of them.

4.1 The Coalition for Networked Information (CNI), sponsored by ARL, CAUSE, and EDUCOM, has as its mission statement: "...to promote the creation of and access to information resources in networked environments in order to enrich scholarship and to enhance intellectual productivity."

4.2 The Internet Society was founded this year as an international organization for standards establishment, coordination, and promotion of Internet use and applications. The Society maintains a list of Internet service providers around the world.

4.3 With partial funding from the NSF's Program on Ethics and Values Studies in Science and Technology, a joint project has been undertaken by the CNI and the Science, Technology, and Public Policy Program at Harvard University's John F. Kennedy School of Government. The goal of this Information Infrastructure Project is to assist groups, such as research teams and academic and professional societies, in establishing appropriate policies and practices for the new forms of scholarly communication that are expected to arise on interconnected networks. A recent draft background paper [KAHI92] identifies six issues to be addressed, including joint authorship and ownership, rights in computer conferencing, derivative and iterative works, control of dissemination, site licensing, and international access.

4.4 Established in 1988, the Scholarly Communications Project of Virginia Polytechnic Institute and State University has been examining the practical aspects of electronic communication of scholarly information. As a working demonstration of the concept of electronic, scholarly, peer-reviewed journals marketed and distributed via electronic networks, the Scholarly Communications Project currently publishes the Journal of the International Academy of Hospitality Research.

4.5 In addition to the projects and organizations cited above as involved in examining potentials for new forms of scholarly communication, numerous writers and speakers are addressing perceived issues and anticipated changes and impacts. A thoughtful article by A. Okerson, Director for the Office of Scientific and Academic Publishing for the Association of Research Libraries, reflects on rapidly evolving changes in scholarly, including scientific, communication. [OKER91] In her article she reviews current trends in electronic scholarly publishing and projects a likely future. In this probable future she sees the traditional paper scholarly journal as minimally supplemented, and possibly replaced, through electronic media. She concludes that this evolution will not only include a change in media from paper to electronic, but that it is likely to create forms of scholarly discourse that are distinctly different from those in place over the last 200 years.

Another provocative and prolific writer, S. Harnad, has published numerous articles relating to his research in the field of cognitive science as well as on scholarly communication. [HARN91] Based upon his recent experiences using electronic discussion groups on the NET and in co-editing the electronic journal *Psycoloquy*, where a practice called "open peer commentary" encourages collegial dialog, Harnad forecasts revolutionary changes in scholarly communication. Harnad's ideas merge together current informal and formal scientific communication forms into a process he calls "scholarly skywriting" [HARN90]. Using the high speed of the NET together with committed scientists and peer reviewers, authoring scientists post their current ideas and findings to the NET where they are peer-reviewed within hours and feedback is provided back to the author. While Harnad admits that this process primarily facilitates the initial phases of research, in a forthcoming article in *College & Research Libraries* he promises to defend his position that the process will effectively replace the traditional formal method of paper-based, peer-reviewed journals.

5 INFORMAL COMMUNICATION

In exchanging data, resources, ideas, and information through informal means, scientists engage in collegial and collaborative ways. Writing in 1990, R. Larsen sees the growing availability of the NET together with increasingly powerful machines and capabilities, complimented by vast data and information resources, as the basis for the future "colibratory." [LARS90] His vision is shared by P. Denning [DENN89] as he anticipates the ubiquitous and pervasive "Worldnet." Denning sees general implications for the NASA-conducted Telescience Testbed Pilot Program that studies interactions with remote instruments supplying data streams to collaborating researchers. [LEIN89b] And the U.S. NSF has articulated a research agenda for a national "collaboratory" through which scientists at remote laboratories could collaborate interactively using advanced workstations with audio and video capabilities and screen sharing programs transmitting nearly interactively between distant locations. [LEDE89] Although such concepts and the resources upon which they are predicated are not yet available outside pilot applications, commonly available electronic capabilities on the NET are supporting informal scientific communication today. These are discussed briefly below.

Some of the same technologies discussed in this paper are being implemented to support distance learning programs in education as well as to improve the flexibility and effectiveness of education programs at all levels of current educational systems. [EDUCAT] The U.S. HPCC Program is encouraging the U.S. education system to use the technologies that support advanced scientific research. The communication and machine simulation and visualization applications developed for scientific research are not only being used to link researchers, educators, and learners, but also are being tailored to help teachers and students to understand scientific methodologies and specific concepts. [OSTP92]

5.1 Electronic mail (e-mail), bulletin board systems (BBSs), file transfer, and discussion groups are rapidly replacing many of the functions of conventional letters, telephone calls, personal visits, "snail mail," paper newsletters, catalogs, information lists, and meetings/conferences in facilitating informal scientific communication. The use of e-mail currently accounts for the majority of transactions on the NET. It provides the conduit not only for personal and office correspondence, but also for access to stored documents. Increasingly, scientists are using e-mail to assist in global, collaborative research experiments, especially for functions such as scheduling experiments and other logistics.

Electronic BBSs are used to present lists of professional opportunities and meetings and to direct users to researchers and experts. File transfer capabilities provide software and data distribution over the NET. More than a thousand scholarly electronic discussion groups (also referred to as listservs or computer conferences) exist on the NET. Some are moderated, others are not. These electronic group discussions provide focus for electronic discussion of specific topics of interest to those who subscribe or participate. Once registered, subscribers automatically receive all messages sent to the discussion group. As larger bandwidths are made available in the communications channels of the NET, full-motion videoconferencing will be available to support multimedia information interchange among a group of participants interactively.

5.2 The great lexicographer, Dr. Samuel Johnson, said, *"Knowledge is of two kinds: We know a subject ourselves, or we know where we can find information upon it."* Centuries later, with the volume of published scientific literature doubling each decade, knowing where to find information and obtaining relevant information in a useful form is increasingly complex and perhaps no longer within the reach of individuals. Information access is a challenge that will be met with increasingly sophisticated electronic tools. These tools will be built using research currently being conducted in expert systems, artificial knowledge, neural networks, semantic networks, nonsemantic retrieval networks, etc.

These information tools will use the catalogs and directories already emerging on the NET. More than a thousand library catalogs currently are available over the NET. Commercial information service providers, such as Dialog, currently make their services available through the NET. And government information services such as NASA/RECON and ESA/IRS are available through the NET. Additional directories of resources exist and are being expanded for enhanced access to the array of data and information.

An intriguing concept for mediating the vast, and ever-growing, data and information resources available on the NET recently has been proffered by Vincent Cerf, current president of the recently established Corporation for National Research Initiatives. The concept calls for development and implementation of "knowbots" (short for knowledge collecting robots). Also known as "data drones" or "intelligent agents," knowbots are computer programs designed to self-navigate throughout networks such as the NET. They are designed not only to search unattended for information in a single network, but using their underlying knowledge bases, will travel from network to network and "clone themselves, transport other knowbots, and respond to requests from each other." [MCCA92]

5.3 An ever-expanding wealth of material is disseminated and delivered through the NET. In addition to access to traditional bibliographic information services, several initiatives in electronic document delivery are being deployed on the NET or in local- and wide-area networks. Some of these are identified below.

Earlier this year the Elsevier Science Publishing Company, Inc., the largest English-language research publisher, announced a project called The University Licensing Program (TULIP). Through the TULIP project, Elsevier will distribute 42 of its materials science journals electronically over the NET to approximately 15 universities. The project has been touted as the first to provide copyrighted, published information over the NET.

NASA is coordinating the Study of Electronic Literature for Astronomical Research (STELAR) project. Through this project, NASA scientists and information professionals, scientific societies, and journal publishers jointly are exploring the use of the NET to provide sophisticated search, retrieval, and electronic access to articles in leading refereed journals in astronomy. By late 1992, a file server at Engineering Information, Inc., will begin electronic document delivery over the NET. OCLC, FAXON, and others also are examining technical and legal issues to full document delivery over the NET.

Some pioneering projects currently are under way that use campus-wide networks for information dissemination. The Chemistry Online Retrieval Experiment (CORE) project currently being conducted at Cornell University is a collaborative effort between the American Chemical Society (ACS), Bellcore, Chemical Abstracts Service, Cornell University, and OCLC. In this project, both the text and the graphics of articles appearing in the 20 journals published by ACS are provided over the campus network. Users interactions with retrieval and display are being carefully studied. Carnegie Mellon University is conducting Project Mercury. This project has as its goal the ready delivery of information to the desktop of each student and faculty member.

At AT&T Bell Laboratories, the RightPages electronic library prototype is taking advantage of fast hardware, multimedia workstations, and broadband networks to make scientific and technical journals available over a network for users at AT&T Bell Laboratories. The State University of New York (SUNY) plans to begin construction of a digital library next year. The digital library would be made available over the NET to the 65 campuses in the SUNY system. These developments are not limited to the U.S. The Bibliothèque Nationale is a national initiative in France. One of its objectives is to centralize library material and make it available electronically.

6 FORMAL COMMUNICATION

The first scientific journals, the *Journal des Scavans* and the *Philosophical Transactions of the Royal Society*, appeared in 1665 and supplanted the existing practices for scientific communication, which relied on correspondence, exchange of personal reports of experiments and findings, and private printing. Throughout the intervening 327 years, the scientific journal has operated as the primary repository of research findings as well as the primary channel of communication in science.

There are many other types of formal written communication in scientific disciplines. These include the preprint, conference proceedings, technical report, dissertation or thesis, monograph, popular journal, and newsletters. In addition, there are variances in preference and emphasis among the different scientific disciplines for certain types of communication. For instance, B. Cronin [CRON82] indicates that in many humanities and social science disciplines the publication of a monograph is viewed as a more important potential contribution to knowledge than the publication of an article in a refereed journal. The opposite emphasis appears to operate in the disciplines of natural and applied sciences. However, in general the refereed journal is the most accepted type of publication within the scientific community [ALLE91] and will be the focus of this brief discussion of formal scientific communication.

6.1 Several unsuccessful efforts to create new formats and types of journals are discussed in an article by A. Piternick. [PITE89] Since Piternick's article was published in 1989, several electronic journals have become available over the NET. Although these electronic journals currently do not include color or graphics, future electronic journals likely will include charts, graphs, tables, illustrations, and scientific notation along with text. Both economics and technological developments likely also will permit future electronic journals to include data files, analytical tools such as algorithms for solving equations, motion simulations, and video and sound.

The Association of Research Libraries (ARL) has issued a directory that details the electronic journals and newsletters that currently are available through the NET. The directory lists 36 active electronic journals, of which 10 are recorded as refereed journals. Extracting selected information from this directory, Table 2 (on next three pages) was prepared.

Plans for other, new electronic journals have been announced, including the NSF's Electronic Journal of Scientific Database Research and the American Association for the Advancement of Science's (AAAS) Online Journal of Current Clinical Trials. Also, the American Mathematical Society (AMS) recently announced development plans for a model electronic journal. This model will use NET databases and utilities exclusively to support manuscript preparation, editorial processing, revision control, peer review, peer commentary, production, and distribution. Approximately 90 newsletter titles are listed in the ARL directory as available over the NET. In addition to the traditional printed version of this directory, an electronic version is maintained and is available on the NET.

6.2 Arguments abound regarding likely electronic journal concepts and forms. And several writers suggest that the current printed forms of scholarly journals and evolving, electronic forms will coexist for at least the next decade or perhaps into the foreseeable future. [GARF91] What does not seem to be denied is that access and delivery will be electronic, and that a virtual "electronic library" will unfold.

JOURNAL	SUBJECT MATTER	SUBSCRIPTION INFORMATION
Art Com	Contemporary art and new communication technologies.	WELL - Enter g acen at the Ok: prompt USENET - alt.artcom
ArtsNet Review	An Australian magazine dedicated to contemporary cross-cultural, arts and electronic networking issues.	Send e-mail to suephil@peg.pegasus.oz.au with subscription request.
Bryn Mawr Classical Review	Electronic book review journal.	Send e-mail to mailserv@brynmawr.bitnet or to mailserv@brynmawr.edu with the text SUBSCRIBE BMCR-L.
CATALYST*	The Community Services Catalyst is a refereed electronic journal serving community college educators.	Send e-mail to listserv@vtvm1.bitnet or listserv@vtvm1.cc.vt.edu with the text SUBSCRIBE CATALYST Subscriber's Name.
CONTENTS	CONTENTS, the Religious Studies Publications Journal, is an electronic serial for religious studies.	Send e-mail to listserv@uottawa.bitnet or listserv@acadvm1.uottawa.ca with the text SUBSCRIBE CONTENTS Subscriber's Name.
CORE	An electronic literary journal for short fiction, poetry, and networks.	Send e-mail to core-journal@eff.org with subscription request.
DargonZine	Dargon Project fiction anthology.	Send e-mail to white@duvm.bitnet with subscription request and Userid and Subscriber's Name.
DEOSNEWS	The Distance Education Online Symposium.	
DISTED	DISTED, the Online Journal of Distance Education and Communication, is interested in projects concerned with overcoming geographic, cultural, and socioeconomic barriers in education through the use of electronic communication.	Send e-mail to listserv@uwavm.bitnet with the text SUB DISTED Subscriber's Name
EJournal*	A peer-reviewed, academic electronic journal concerned with the implications of electronic documents and networks.	Send e-mail to listserv@albnyvm1 with the text SUB EJRNL Subscriber's Name.
EJASA	The Electronic Journal of the Astronomical Society of the Atlantic dedicated to the advancement of amateur and professional astronomy and space exploration.	USENET - sci.astro
EJC/REC*	The Electronic Journal of Communication/ La Revue Electronique de Communication is dedicated to communication theory, research, practice, and policy.	Send e-mail to comserve@rpiecs.bitnet or comserve@vm.ecs.rpi.edu with the text JOIN EJCREC Subscriber's Name.
Fineart Forum	A moderated electronic newsletter covering all applications of science and technology to the contemporary arts and music.	Send e-mail to fast@garnet.berkeley.edu or fast@ucbgarne.bitnet with the text SUB FINE-ART Subscriber's e-mail address, full name, and postal address.
Flora Online*	Peer-reviewed electronic journal for systematic botany. Includes original data-intensive studies or original programs dealing with botanical topics.	Anonymous FTP at huh.harvard.edu or electronic BBS at 716/896-7581 (8-N-1).
Intertext	Intertext, an electronic fiction digest, is a bimonthly magazine devoted to the publication of quality fiction.	Send e-mail to jsnell@ucsd.edu with subscription request and specify ASCII or PostScript.

* *Indicates a peer-reviewed journal.*

Source: Directory of Electronic Journals and Newsletters; compiled by Michael Strangelove (441495@acadvm1.uottawa.ca)

Table 2. More than 35 electronic journals are available over the NET.

JOURNAL	SUBJECT MATTER	SUBSCRIPTION INFORMATION
IOUDAIOS Review	A serial electronic journal of the international electronic forum for scholarship on Early Judaism and Christian Origins. It uses a simplified SGML system to facilitate electronic distribution.	Send e-mail to listserv@yorkvm1.bitnet or listserv@vm1.yoorku.ca with the text SUB IOUDAIOS Subscriber's Name
Issues in Science and Technology Librarianship	A publication of the Science and Technology Section of the Association of College and Research Libraries, American Library Association, that is dedicated to topics relevant to science and technology librarianship.	Send e-mail to acrlsts@hal.unm.edu with a subscription request.
JIAHR*	The Journal of the International Academy of Hospitality Research contains refereed articles on basic and applied research in all aspects of hospitality and tourism.	Contact the editor and publisher at jiahred@vtvm1.bitnet or jiahred@vtvm1.cc.vt.edu (Price: $30 per year for institutions, $20 for individuals, $10 for students).
JTE	The Journal of Technology Education provides an electronic forum for scholarly discussion on topics relating to technology education (that is, the "industrial arts").	Send e-mail to listserv@vtvm1.cc.vt.edu with the text JTE-L.
LIBRES	The Library and Information Science Research Electronic Conference (LIBRES) is an electronic journal designed to foster library and information science research and support the development of its knowledge base.	Send e-mail to listserv@kentvm.bitnet or listserve@kentvm.kent.edu with the text SUB LIBRES Subscriber's Name.
MeckJournal	A monthly electronic journal from Meckler Publishing, MeckJournal contains editorials, late-breaking news, and feature articles published in any of Meckler's 14 technology-related periodicals.	Send e-mail to meckler@jvnc.net with the text Subscribe MeckJournal Userid.
New Horizons in Adult Education*	New Horizons in Adult Education is a refereed electronic journal devoted to research within adult education and related fields.	Send e-mail to aednet@suvm.bitnet or aednet.suvm.acs.syr.edu with a subscription request and Userid and Subscriber's name.
OFFLINE	OFFLINE began as a service of the Computer Assisted Research Group of the Society of Biblical Literature, but it attempts to cover more widely the actual and potential use of computers in religious studies in general.	To retrieve a list of files, send e-mail to listserv@brownvm.bitnet with the text GET HUMANIST FILELIST.
PACSNEWS	PACSNEWS, the Public-Access Computer Systems News, is a copyrighted electronic newsletter that contains brief news items about end-user computer systems in libraries.	To retrieve an issue, send e-mail to listserv@uhupvm1.bitnet or listserv@uhupvm1.uh.edu with the text GET PACSNEWS V?N? F=MAIL, where ? is the appropriate issue volume (1 or 2) and number (1 through 12).
PACS Review	The Public-Access Computer Systems Review is a refereed electronic journal about end-user computer systems in libraries. It covers such topics as CD-ROM databases, electronic publishing, expert systems, and hypertext programs.	Send e-mail to listserv@uhupvm1.bitnet or listserv@uhupvm1.uh.edu with the text SUBSCRIBE PACS-L Subscriber's Name.

* *Indicates a peer-reviewed journal.*

Source: Directory of Electronic Journals and Newsletters; compiled by Michael Strangelove (441495@acadvm1.uottawa.ca)

JOURNAL	SUBJECT MATTER	SUBSCRIPTION INFORMATION
PostModern Culture*	An electronic journal of interdisciplinary studies that publishes analytical essays and reviews as well as video scripts and other new literary forms.	Send e-mail to listserve@ncsuvm.bitnet or listserve@ncsuvm.cc.mcsu.edu with the text SUB PMC-LIST Subscriber's Name.
PSYCOLOQUY*	PSYCOLOQUY is a refereed electronic journal sponsored by the American Psychological Association's Science Directorate and Office of Publication and Communication. PSYCOLOQUY published brief reports of ideas and findings in all areas of psychology and its related fields.	Send e-mail to listserv@pucc.bitnet or listserv@pucc.princeton.edu with the text SUB PSYC Subscriber's Name
Quanta	Quanta, the electronic magazine of Science Fiction and Fantasy, publishes fiction by amateur and professional authors. Quanta is available for downloading in either PostScript or ASCII format.	For PostScript subscription, send e-mail to quanta+requests-postscript@andrew.bitnet or quanta+requests-postscript@andrew.cmu.edu; For ASCII subscription, send e-mail to quanta+requests-ascii@andrew.bitnet or quanta+requests-ascii@andrew.cmu.edu
RD*	RD: Graduate Research in the Arts is a refereed journal dedicated to publishing the work of graduate scholars in the Arts, Fine Arts, and Humanities.	Send e-mail to rd@writer.yorku.ca.bitnet with a subscription request and Subscriber's Name and status (student, faculty, other).
Solstice*	Solstice: An Electronic Journal of Geography and Mathematics is a copyrighted, refereed electronic journal published by the Institute of Mathematical Geography (IMaGe).	Send e-mail to solstice@umichum.bitnet or sandy.arlinghaus@um.cc.umich.edu with a subscription request and Userid.
TeXMaG	TeXMaG is a monthly electronic magazine published by the Academic Computing Services of Texas A&M University.	Send e-mail to listserv@uicvm.bitnet or listserv@uicvm.uic.edu with the text SUBS TEXMAG-L Subscriber's Name.
TeX-Pubs	TeX-Pubs is a redistribution list for TeX-related electronic form periodicals. The distribution of TeX-Pubs includes TeXhax Digest, UKTeX, TeXMaG, and others.	Send e-mail to listserv@shsu.bitnet or listserv@shsu.edu with the text SUBSCRIBE TeX-Pubs.

* *Indicates a peer-reviewed journal.*

Source: Directory of Electronic Journals and Newsletters; compiled by Michael Strangelove (441495@acadvm1.uottawa.ca)

Approaches to concepts of the electronic journal range from mere duplication of current printed journal formats in an electronically accessible form available through the NET to more revolutionary concepts such as S. Harnad's "scholarly skywriting" concept. [HARN90] Within this range, some writers call for the replacement of the category called "journal" with a category called "electronic archives." The envisioned electronic archives would retain selected characteristics of current printed journals, such as editorial boards and peer review, but use technology to offer retrieval features for accessing a single article as well as a related body of literature, for placing comments and rebuttals to individual articles within the electronic archive, and for automatically notifying users of new additions to the archive that are likely to be of interest to them. [HARR91]

Writing in the journal *Academic Computing* [SEIL89], L. Seiler contemplates altered forms for scholarly communication. After claiming that the scholarly journal will not retain its current format, Seiler explores the constraints of the current format and offers suggested electronic alternatives that are likely to better serve the interests of scholarship. She argues that "journals will change because the information scholars produce is not limited to what the print medium can encompass. Movies, video and audio tapes, and numerical databases are essential materials for scholarly investigation but are beyond what the print medium by itself can address." In her view the formal scholarly communication of the future will consist of hypermediated electronic journal articles accessed from high-resolution color display devices. Before concluding the article, Seiler presents a wide-ranging discussion of the probable repercussions of this revolutionary change in communication forms.

6.3 Entire books have been written on the subject of peer review in science. Nearly every article or report that examines the future of scientific communication or the future of scholarly journals addresses the topic, although in varying degrees. And while many writers claim that the existing process used to conduct peer review is plagued with bias, delays, errors, and inconsistencies, for the majority of these writers, peer review is essential to assure a level of quality in formal journal publication. In considering the viability of peer review, little differentiation is made between the printed and electronic formats of reviewed journals.

In a recent journal article [LIPE91], R. Lipetz argues against the abandonment of peer reviewing. He anticipates a future

in which emerging technologies can be used to assist reviewers in their work, making them more productive and effective. In *Scientific Literacy and the Myth of the Scientific Method* [BUAE92], author H. Bauer suggests that "even moderately successful scientists learn to adjust to the predictability and mediocrity of peer review." In a book entitled *Peerless Science* [CHUB/HACK90], Chubin and Hackett disparage the dearth of legitimate studies of the journal peer review process. They argue that the process as it is presently practiced is subject to contradictory, and often conflicting, forces. They view peer review as "shamelessly secretive, elitist, and oligarchic—as is science itself." A practice that Chubin and Hackett encourage as a workable alternative to current journal peer review methods is the "open peer commentary," also promulgated by Harnad [HARN91].

In considering what she views as the inevitable replacement of printed scholarly journals with electronic forms, Seiler [SEIL89] discusses the provisions needed for the electronic environment. She does not criticize current peer review practices, but does raise questions about the means for distinguishing between information on the NET that has been quality-assured, such as refereed articles, and information available on the NET that is not constrained, such as e-mail, BBSs, and discussion groups/conferences. She notes that a common user interface could likely obscure the relative quality of various units of information.

7 CHALLENGES

The challenges to the pervasive and effective use of information technology in scientific communication can be characterized as financial, technical, legal, political, social, and operational. Table 3 (at right) provides a listing of challenges in each of these categories.

8 WORLDWIDE SCIENTIFIC "INVISIBLE COLLEGE" PARADIGM

Will the paradigms of informal and formal communication among scientists change with the pervasive use of integrated and advanced information technologies? According to many writers it is inevitable that they will. However, the speed of such paradigm shifts and the success of specific innovations will be dependent upon the recognition among developers of innovative tools and media of the variations among different scientific disciplines in their social practices and their needs for information and communication. Successful innovation will be user-centered.

8.1 Emerging themselves in this century in pursuit of a recognized distinct subdiscipline, researchers in the sociology of science have been studying and documenting the various social practices among scientists in general as well as among specific scientific disciplines. And while there certainly is not consensus among these researchers regarding the complex dimensions of human communication, whether formal or informal, among scientists, some views have achieved popular appeal as well as academic acceptance. One of these accepted views was first documented by Derek Price in his now famous books entitled *Science Since Babylon*, published in 1961, and *Little Science, Big Science*, first published in 1963. Masterful in his use of vivid metaphors, Price revived the 17th century term "invisible college" to characterize the informal networks of communication and collaboration among scientists. Many of Price's early observations and interpretations have been confirmed and extended by the studies of Crane [CRAN72] and Mullins [MULL73] and further explored in hundreds of articles and monographs. [CHUB83]

Whether Price's phrase "invisible college" or the phrases "reference group" or "cultural circle" are used, respected sociologists of science [CHUB85; CRAN72; KUHN70; MERT73; MULL73; MULK91; PRIC61; PRIC63; and PRIC/BEAV83] argue convincingly that scientists engage in informal communications with individuals whom they trust to be effective assessors of and advisors for their research. Regarding formal communication, the sociologists of science view that scientists publish formally to register their discoveries, to garner recognition for their work, and to satisfy institutional requirements for appointments, tenure, and funding. Paradigms for scientific communication, including

CATEGORY	CHALLENGES
Financial	• Accounting and charging for use of licensed products, databases, and information resources • Cost recovery for network, computing, and information services • Economic models • Resource sharing • Global market
Technical	• Appropriate standards for network-accessible information • Responsibility for network management and operations • Software interchange capability • Access to large-scale databases • Improved user-level tools • Preservation and citation conventions • Authentication
Legal	• Licensing provisions for network and information resources • Intellectual property rights and fair use • Privacy and security considerations
Political	• Appropriate science research funding and evaluation • Monitoring national social agenda • Network funding, privatization/ commercialization • Global relations
Social	• New forms of communication and relating among individuals and groups • Equity in access to information and resources • Technology transfer
Operational	• Service to a growing community of non-expert users • Directories for locating computing, data, and information resources • Avoiding information pollution • System reliability • Availability of skilled workforce

Table 3. Challenges to the pervasive and effective use of information technology.

current ones as well as those hypothesized for the future, must acknowledge these underlying general motivations for communication in science.

8.2 The envisioned global research enterprise using interconnected information technologies is likely not only to make scientific research more productive but to make more visible and accessible both the informal and formal communications between scientists, creating a worldwide "invisible college." In the process, the number of members in each scientist's trusted reference group could expand, and could even include trusted machines, as the envisioned "intelligent agents" or "software mediators" become fully known.

The total of both anticipated and unanticipated change is often referred to as a "revolution" with far-reaching effects comparable to those introduced by the discovery of fire, the development of human language, and the construction of the printing press. Often without specifics regarding the changes resulting from this most recent revolution, the changes frequently are characterized as of great magnitude and deeply altering our lives and societies.

No doubt exists that the new and emerging electronic technologies will challenge existing paradigms and even produce new ones based upon an increasingly global scientific research enterprise. But the speed with which the paradigms might change will be influenced by the financial, technical, politico-social, and legal concerns cited by so many of the writers who are examining both the facilitators and the impediments to more productive scientific research and knowledge development.

What is obvious is that scientists, academic/professional societies, and the institutions funding research, along with librarians/information professionals, are challenging commercial publishers for more economic, efficient, and effective scientific information communication and exchange. Researchers, research organizations, and societies increasingly are recognizing that they, and not commercial publishers, are both the generators and the controllers of quality scientific information and literature.

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Integrated access to distributed databases through intelligent interfaces

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SUMMARY

The **IANI** interface is one of many attempts to produce efficient access to databases on different hosts. **IANI** stands for Intelligent access to Nordic information and was started as a project by the **Nordic Council for Scientific Information** in 1986.

The aim of the project was to produce an interface which would allow Nordic users to access Nordic databases with **one** login procedure and **one** command language. The development of the prototype was a true cooperative exercise involving the Danish contractor **CRI** and the hosts of union catalogues in Denmark, Finland and Sweden. After implementation of the prototype software, a Norwegian union catalogue host was added.

The prototype was developed for an IBM-compatible PC. Later the software has been ported to a UNIX machine where IANI may serve as a gateway in specific applications. It has e.g. been used in an information training scheme by the Ministry of Education for Danish school children.

The IANI concept has turned out to be a useful tool for integration of groups of databases. In 1991 it was used for integrated access to the catalogues of libraries of the major European Institutions in the EUROLIB-project.

The attempts to integrate the database world through IANI have demonstrated that it is feasible to produce integrated database access in a few weeks. Experience has, however, also shown that database and network access procedures are changed so frequently, that the maintenance costs for interface products are high.

The next step on the way towards integration of databases is expected to be implementation of the new ISO Search and Retrieve Standard which now is being used in pilot projects sponsored by e.g. NORDINFO and the Commission of EC.

The paper concludes in a recommendation to use the many interface prototypes which have been produced in international R&D programmes, but still needs futher development in order to become stable products which can be sold to the information world.

LIST OF ACRONYMS

CATEL: Catalogue of Publications of the EC
CORDIS: Community R&D Information Service
CCL: Common Command Language (ISO 8777)
CRI: Computer Resources International A/S
ECHO: EC Host Organisation (Luxembourg)
ECLAS: EC Library Catalogue
EPOQUE: Documents of the Eur. Parliament
ESPRIT: Eur. Strategic Programme f. Res. in IT
EUI: European University Institute, (Florence)
EUROLIB: Eur. Institutional Libraries project
EUROVOC: Thesaurus of the Eur. Parliament and Office f. Official Publications
IANI: Intelligent Access to Nordic Information
IMPACT: Information Market Policy Actions
INSIS: Inter-institutional info. system of the EC
ION: Interlending OSI pilot project between library networks
NORDINFO: Nordic Council f. Scientific Information
OSI: Open systems interconnection standard
Sko-Da: Database service f. Danish Public Schools
SR: Search & Retrieve Standard (ISO 10163)

1. BACKGROUND

In the mid eighties the recurrent problem of the actors on the information market was that the databases neither in Europe nor in the US seemed to be used as much as they ought to. The worry of those who had actually tried to become users was that it was felt too complicated to try to cope with all the different search languages, login procedures etc., as it has been said in paper after paper and in numerous introductions to projects which have aimed of eventually solving these problems (Ref 1).

A considerable number of projects was in fact initiated to overcome these barriers - as research projects in **ESPRIT**, in "closer to market programmes" like **IMPACT** and in many other national or international contexts.

In 1992 - after almost a decade of research and development in the field of intelligent interfaces, and

after investment of several hundreds of manyears, it is rather sad to say, that the need for this type of products is as high as ever, but that most of the prototypes developed as result of the R&D investment never managed to reach a commercial state. As a result every call for proposals in the field of information technology will inevitably attract several proposals suggesting to produce yet another prototype interface which should make it easier for the user to access the databases of the world.

In the following I shall present some of the experiences I have had over the last 6 years as actor in the world of intelligent interfaces, summarize my conclusions and try to describe some of the steps which in my opinion should be taken in order to intensify the use of the databases everybody are trying so hard to "sell" to the information market.

2. IANI: INTELLIGENT ACCESS TO NORDIC INFORMATION

The project I shall use as example is called IANI (Intelligent Access to Nordic Information). It was initiated by NORDINFO (The Nordic Council for scientific information) in 1986, and the first prototype was demonstrated at the DATABASE 88 conference in Stockholm in January 1988 (Ref 2,3,4).

The original aim of the project was to give easy and uniform access to Nordic databases. By the start of the IANI project the Nordic Database Guide (Ref 5) contained appr. 300 Nordic databases, which were used very little, not only in the neighbouring Nordic countries, but also in their country of origine. The databases were in different languages, and they displayed a wide variety of different database structures, search languages and login procedures. Many did not even have a database structure, and their documentation was often next to non-existent.

2.1 Aims and ambitions

The ambition of NORDINFO was to bring some kind of homogeneity into this diversified picture, while at the same time removing some of the barriers which prevented the Nordic databases from getting anywhere near a commercial situation. The goal was to offer access to eventually most of the Nordic databases with one login procedure and one command language. Another ambition was to stimulate use of standards in the library and information world. The Common Command Language (CCL) was at the start of the IANI project just about to be acknowledged as ISO-standard (ISO 8777), and also the OSI-model (Open systems interconnection) was beginning to reach a state where it could help to simplify exchange of messages between different information retrieval systems.

2.2 The partners

It was decided to develop the interface in a "live environment" involving 3 Nordic hosts with large operational databases. The selected databases where the union catalogues of the research libraries in Denmark, Finland and Sweden, which were very different and in some cases very much "pre-standard". The project was financed by NORDINFO, and the Danish software house, CRI (Computer Resources International) was chosen as contractor. The Norwegian semi-commercial library and information consultants, BRODD, acted as subcontractor (Fig. 1).

It was decided to develop the interface as a PC-prototype on an IBM-AT model, and 15 months after the start of the project the first prototype was demonstrated at a Nordic exhibition. This prototype was not stable, but it worked most of the time, certainly when we had the expert at hand to solve the problems which e.g. was encountered during installation at new sites. It all looked very promising, but we should gradually realize that that there is a long way from the almost ready prototype to the stable product which can go on the market.

Debugging and trimming of the prototype took a long time and it became gradually apparent that the PC of 1989 simply did not have the capacity to handle the tools which could have traced the errors quickly. Since it at that time in any case already had been decided that the prototype should be ported to UNIX which by then was the upcoming standard, it was decided to port the software and try to locate the bugs on the bigger SUN workstation.

The stability of the product now is now acceptable, if one important condition is fulfilled: that the databases to be accessed via the interface are kept reasonably stable too, and that the login procedures of hosts and network are kept unchanged.

The concept and design of IANI has shown its strength in the sense that addition of new hosts can be made quite easily. The Norwegian union catalogue, BIBSYS, has been linked to the other Nordic databases to create a distributed Nordic library database with hosts in 4 countries, and in a special project for the Nordic Industrial Foundation a IANI version was developed which enables the Nordic industrial attachees distributed all over the world to search all the databases which are considered interesting for their work. This version of IANI gives easy access to appr.

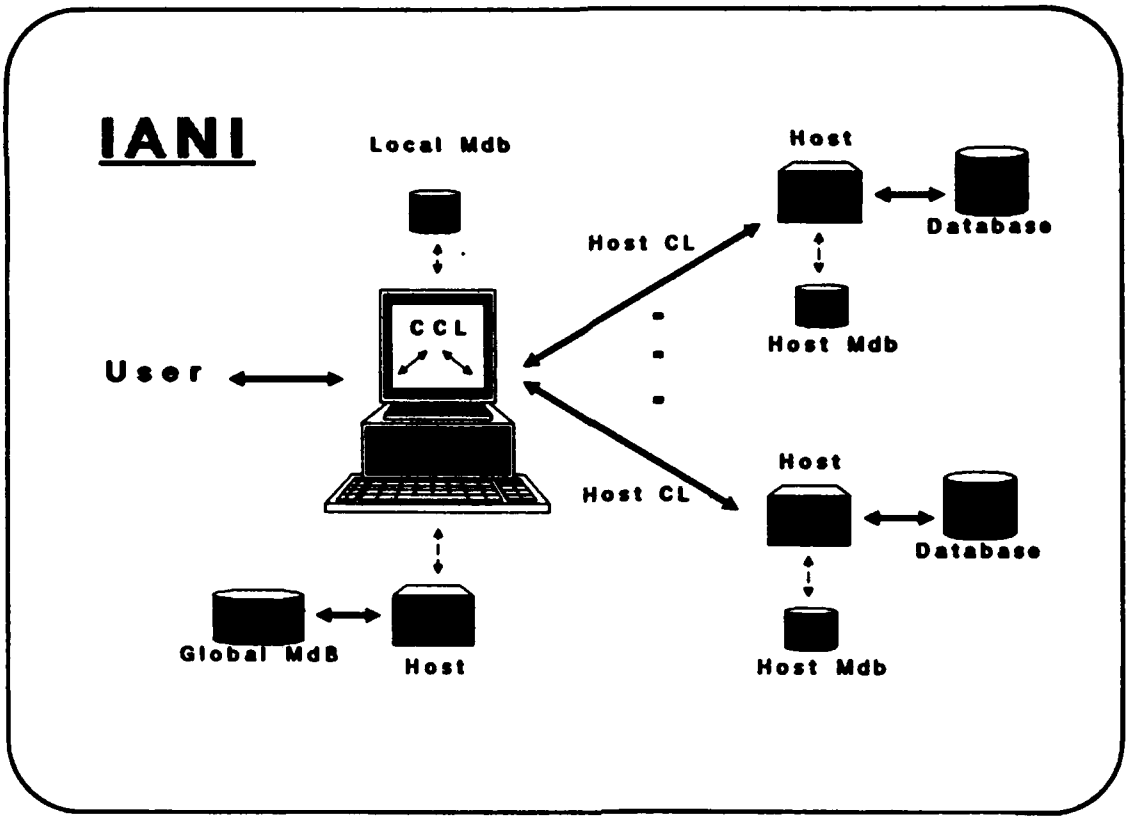

Fig. 1: The IANI prototype gives access to the Nordic union catalogues. The IANI interface "translates" the user statement into CCL and from CCL into the retrieval language of the host. The description of the host, the databases, and query languages are stored in the metadatabases.

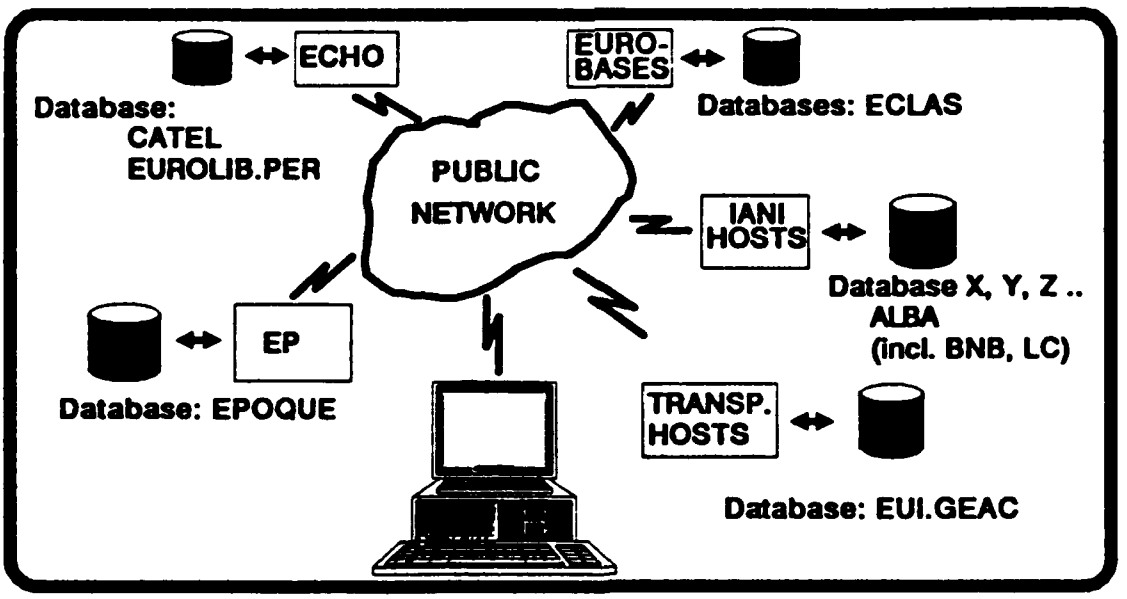

Fig. 2: The EUROLIB prototype gives access to library catalogues of the European Commission, The European Parliament, The European University Institute, The EUROLIB periodical catalogue, CATEL, and to some of the Nordic IANI-hosts.

85 databases on most of the major international hosts (ESA, DIALOG, STN etc.).

3. EUROLIB

In 1991 a European variant of IANI was produced within the socalled EUROLIB-group, consisting of 14 libraries and documentation centres of the European Institutions (e.g. The European Parliament, The European Commission, Court of Justice, European University Institute in Florence, Office for Official Publications, The European Institute of Public Administration, The European Investment Bank, College of Europe in Bruge, The Court of Auditors, The Council of Europe, Council of Ministers) (Ref 6). The EUROLIB prototype gives uniform access to the large and very different databases of these institutions, e.g. EPOQUE (Parliament), ECLAS (Commission), EUI (Florence), CATEL (The catalogue of the official publications) and EUROLIB-PER (a catalogue of the periodicals of the EUROLIB libraries) with the same interface as IANI (Fig. 2). What really is being done here is to create a uniform, decentralised calogue of the documents spread in the European Institutions located all over Europe. As these databases are in several languages (EPOQUE in all 9 official languages of the community), have different classification systems and thesauri, as well as different hardware and software, a quickly developed prototype can, of course, not handle all the facilities of the individual databases. What the prototype has done, has been to demonstrate that a very inhomogenous univers may be accessed as an integrated information system with a very minimal effort.

4. THE Sko-Da PROJECT

A very important application of IANI has been the implementation of the UNIX version as a gateway in a database service offered by the Danish Ministry of Education to Danish Public schools. With this project it is the intention to educate the next generation to make use of the information available from a variety of different sources. At present the pupils have access to library catalogues, parliamentary information, statistical data, a news database from a large Danish newspaper, and a database with information on hazardous chemicals. In this project IANI is installed on a central UNIX machine, which transmits the requests from many different terminals and PCs in the schools to the host computers who participate in the project (Fig. 3).

5. USER ACCEPTANCE?

Since the market is still as waiting for a product with the functionality of IANI as much as it was 6 years ago, one could expect a great sales success now the product is stable.

The answer is no. First of all, because the constant changes of login procedures or database access on the side of the hosts have made the product very expensive to maintain and develop for a commercial software-house. The administration of diskettes which will have to be distributed will alone swallow the revenue which may be expected from the sale of a PC-product. Secondly, because the software will consume a very large part of the storage capacity of the PC.

The prospects for the UNIX-version which may be installed on a central gateway machine seems much better. However, even so the database suppliers and hosts need much more discipline and professionalism in order to make it feasible to think of investing resources in implementation of an intelligent gateway which may include the more sophisticated facilities of some of the databases, like multilingual thesauri, handling of interlibrary loans etc.

The experience with IANI has definitely shown that the more commercial hosts like DIALOG and ESA are quite easy to deal with, since they do not change there procedures so often. Looking at library catalogues like those in the Eurolib institutions the situation is quite different; just over a 4 months period important features were changed both on ECHO, EPOQUE and ECLAS; this must be considered as a great nuisance to the users - not only for CRI who had to change the database descriptions a number of times for the Eurolib prototype.

5.1 Conclusions on IANI-development

The conclusion which may be drawn from the IANI development could be the following:

- o The need for a product with the functionality of IANI still exists.
- o The design enables integration of a large number of hosts in minimum time (appr. 2 manweeks for european integration!)
- o The UNIX version may be used as intelligent gateway on a central machine,

but the pc-version can not be produced on commercial terms for the price which can be expected from PC-users

and even the UNIX version will be expensive to maintain, unless the database producers and hosts (and library users) show more stability, professionalism and cost/benefit awareness.

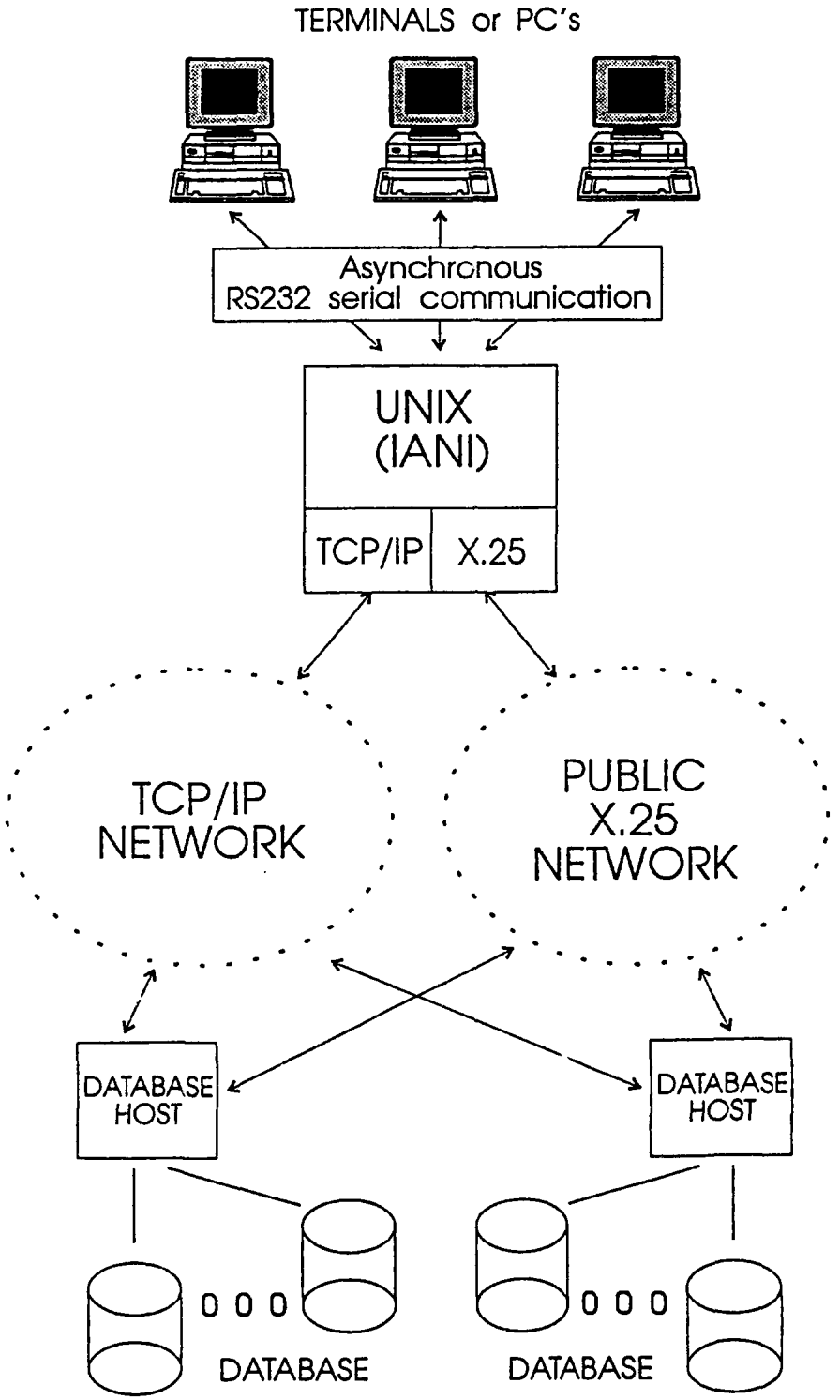

Fig. 3: The IANI/UNIX may be a dedicated machine, which runs IANI and other applications. The users connect to the UNIX machine from terminals or PCs, or through a local area network.

6. NEXT STEP: THE SR-STANDARD

Although the IANI software makes it easy to include a new database and a new host in a distributed database system, the problems of maintaining the interface creates problems, until all the hosts served by the interface will adopt common communication standards. As the OSI Search and Retrieve standard shortly will be an ISO standard (ISO 10163) a number of ongoing projects sponsored e.g. by the European Libraries programme and by NORDINFO are being carried out in order to implement the standard particularly for use in document ordering systems.

The ION project sponsored by the European Commission (Library Programme) is implementing the standard in a Dutch, French, British interlibrary loan project started in 1990, and NORDINFO has started an SR-project in 1991, which shall the use the SR protocol for transfer of messages between some of the same hosts who also participated in IANI. Eventually, it is planned to merge the results of the SR-project with the IANI interface. Even by optimum conditions the standardized transfer of messages between the individual hosts can, however, hardly be operational until appr. 1995 (Ref 7).

7. THE CD-ROM ALTERNATIVE

For interlibrary lending, where accurate and up-to-date information on the exact location of a document is a necessity, there is no real CD-alternative to the online ordering system. However, just for information search and retrieval, it might be attractive to use a database on a CD-ROM instead of searching online in remote catalogues.

Considering the user interest the CD-ROM databases have aroused within a very short time, one could consider whether the information sector might forget all about online databases for the time being, and just offer as much information as possible on CD. In probably many research communities and definetely in the Danish, the pricing of online information services based on pay-as-you-use fees, is very much a barrier for further penetration of online service in the research community. And this applies to all sectors within education and research. The CD-ROM solution, where the users normally will pay for the use of a CD-ROM once and for all, is much better handled by the administrative systems in the higher education sector in Denmark than any online system with unpredictable fees. People are very conscious about the moving taximeter, particular new online users, although in principle the online user community is in favour of a pay-as-you-use policy.

CD-ROMs, further, has the advantage of fairly simple user interfaces, which will probably not lead to an in-depth retrieval of all existing material in a search, but will certainly find you something. And this is after all, what most searchers want. The ideal combination for the user seems to be CD-ROMs with material up to the last year and then online access to the rest. For the database supplier the main problem will be to reach an acceptable revenue and to establish license agreements acceptable to the users, a problem which is still far from being solved.

Another problem which also will have to solved for combined CD-ROM and online databases is the common interface; it would hardly be acceptable if the user should use different search procedures for different parts of the same database.

8. USE THE PROTOTYPES

As mentioned earlier the cheap, simple, attractive, stable interface giving uniform access to a large spectrum of different databases does not yet exist on the market. What does exist is a lot of prototypes and some products, which in most cases rather appear as semi-commercial beta-versions, than fully commercial products. They are in most cases developed with support from national and international research grants and, therefore, in principle available for use by third parties, if they are not utilized by the project partners themselves.

Information about the results of e.g. EC supported research may be found the CORDIS database, which has been created by the EC in order to get the research results known to those who might use them for further development and commercial exploitation. Information about ongoing results and completed projects sponsored by national grants, can in many cases be found in national databases on ongoing research. These databases will also contain other important pieces of information: about projects which did not lead to the intended results, and, therefore, probably should not be repeated straightaway. Why waste further resources on projects, which for some reason or another, are likely not to produce results. The quite exhaustive information generated in relation to the EC programmes should give an indication of where to direct the research - and perhaps even more: what to avoid and not to repeat.

9. INTEGRATION OF A CHANGING INTERNATIONAL INFORMATION SOCIETY

Finally, why talk about intelligent interfaces on a conference on impact of changing international relations on the scientific and technical community?

Has a lot of the interest in making fancy interfaces using expert system technology not been one of those activities which could be described politely as technology-driven or in more plain words as toys for technology freaks? Will these products not in any case be so expensive in development and maintenance that they will be uninteresting in those parts of the world, where the resources have to be invested in the more fundamental and urgent needs of the R&D sector.

Fortunately, I find myself in a position to say, that all attempts to create easier access to the total information resources of the world and to remove the barriers which prevent a better utilization of the available information are sensible and worthwhile. With the development of e.g. the IANI interface we have demonstrated that it is possible to create a tool which can establish a logical integration of databases distributed all over the world with investment of very little extra effort once the basic interface has been designed. With increasing emphasis on standardisation, which will make it very much easier to connect physically distant systems, the development will eventually enable scientists in the third world and in Eastern Europe to share the global knowledge and contribute to create new results.

I think it is important that the scientific human networks which exist in organizations like NATO, encourage scientists to make use of the opportunities for technological integration of the overall knowledge found in databases spread all over the world. Better access to ongoing research as well as exchange of ideas in the early phases of a research project, will eventually lead to new forms of scientific communication, which not necessarily need to wait for the publication of the research results in the scientific literature and will be cheaper than participation in international conferences. - What of course does not mean that neither the high quality journal nor the conferences will disappear. The human element in the exchange of ideas at conferences can, of course, never be replaced by even the most advanced electronic communication.

ACKNOWLEDGEMENTS

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AUTOMATING MULTILINGUAL COMMUNICATION

by

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The integration of Europe and the increasing economic interdependence across continents require an increasing amount of communication across linguistic boundaries. The need for rapid information transfer cannot be met by conventional methods of translation. Thus, the introduction of machine translation seems inevitable. If in the past MT systems had not been entirely successful, advances in hardware as well as linguistic approaches have led to the developmentof viable systems. In the following, the structure of one such operative system will be described in detail.

Information, i.e. access to items of knowledge, has become a basic resource in itself rather than being defined as a mere add-on to physical objects, and so the unimpeded flow of information has acquired a new significance. This information flow, however, is hindered by multilinguality. For political and cultural reasons, the introduction of a lingua franca is impossible. Moreover, not only do we generally overestimate the ability of people to converse with precision in a foreign language, but the sheer magnitude of descriptive detail in e.g. industrial documentation goes way beyond the scope of a general language training.
This situation causes severe problems for export-oriented industry. Technological progress has its price: Sophisticated (and by nature complex) technologies require a much more detailed and extensive documentation. Unlike former self-explanatory implements, modern technologies can no longer be operated without it. To give an example of the magnitude: the documentation of a public switching system may amount to more than 100 000 pages. If such a system is to be exported to a foreign country, industry is faced with the enormous task of having to supply these masses of text in a foreign language in a very short time. But on the average, technical translators cannot produce more than a few pages per day. So if the translation process is handled by conventional means, a long delay between delivery of the product and actual operation is inevitable, and this may quickly lead to a loss of markets.

The same applies to the exchange of scientific research results. If such results are unavailable on account of language barriers, wasteful duplication of efforts or costly errors may follow. On the political side, it is interesting to note that the European Parliament spends more than half of its budget on translation. While there may be plenty of unemployed general-language translators, there is a noticeable shortage of specialized technical translators, and it is mainly in the field of specialized sublanguages (such as technical descriptions) that most voluminous documents with critical deadlines originate. Therefore, besides the European Communities it is mainly in export-oriented industry that the topic of machine translation has been addressed. Within Germany, the most headway has been made with the METAL system developed by Siemens Nixdorf. As it is an example of the state of the art it will be described in some detail.

METAL

After experiments with commercially available systems in the late seventies had proved rather unsuccessful, Siemens entered into a cooperative agreement with the University of Texas with the goal of building an operative MT system that would be able to increase the productivity of in-house translators and reduce turn-around time. The joint effort led to a first prototype in 1979, but it took more than ten years to turn the prototype into an operative system. During the work it had become obvious that the existence of a prototype in natural language processing is of little value because the main problems with ambiguity are not encountered until one has to work with large grammars and large lexicons.

Originally, the system had been implemented on a Symbolics LISP machine with a front-end multi-user translator workstation. While the configuration proved effective, it required a large investment for the hardware, and this of course hindered its marketability.
By now, METAL has been ported to UNIX workstations. A SUN version is available; there is work underway to implement the system on DEC, and a port to Silicon Graphics is planned as well.
The translation throughput with METAL is about 200 pages per day. That of course is far more than a single translator could ever post-edit. So several users are able to access the server from their x-terminals. From these terminals, translation jobs are started and all the tasks of deformatting and reformatting and post-editing are handled. The batch translation process running in the background is detached from other processing steps and does not interfere with any of the tasks at the translator's terminal.

Office Environment

Of course, an operative productive system has to be able to do more than simply translate single sentences entered from the keyboard. Most of the texts which are to be translated quickly and are of significant volume such as technical documentation tend to be heavily formatted. They may contain a lot of non-translatable material: flow charts, diagrams, tables and control characters to define fonts and layout. To extract the text elements manually for translation and re-enter them afterwards would be quite uneconomical. Therefore, METAL is integrated into a chain of automated processes, from text acquisition via automatic deformatting and translation to reformatting procedures. A text is usually received in machine-readable form, by file transfer, floppy disk exchange

or from a font reader. Several programs check the pages for tables and graphs and mark them. They identify the text units to be translated and generate a template of the page. The individual translation units, usually sentences, are automatically recognized, numbered consecutively and extracted from the page template.

After translation, the translated file is returned for post-editing. Translators can choose whether they want to postedit an interlinear version which groups single source language/target language units sentence by sentence, or work on two windows with source and target text. After the machine-translated text has been corrected, the text file is merged with the formatting information which had been stored in the template. Thus, the target language text is available with all the formatting information and with the same layout as the original. The processes in a METAL translation run can be illustrated as follows:

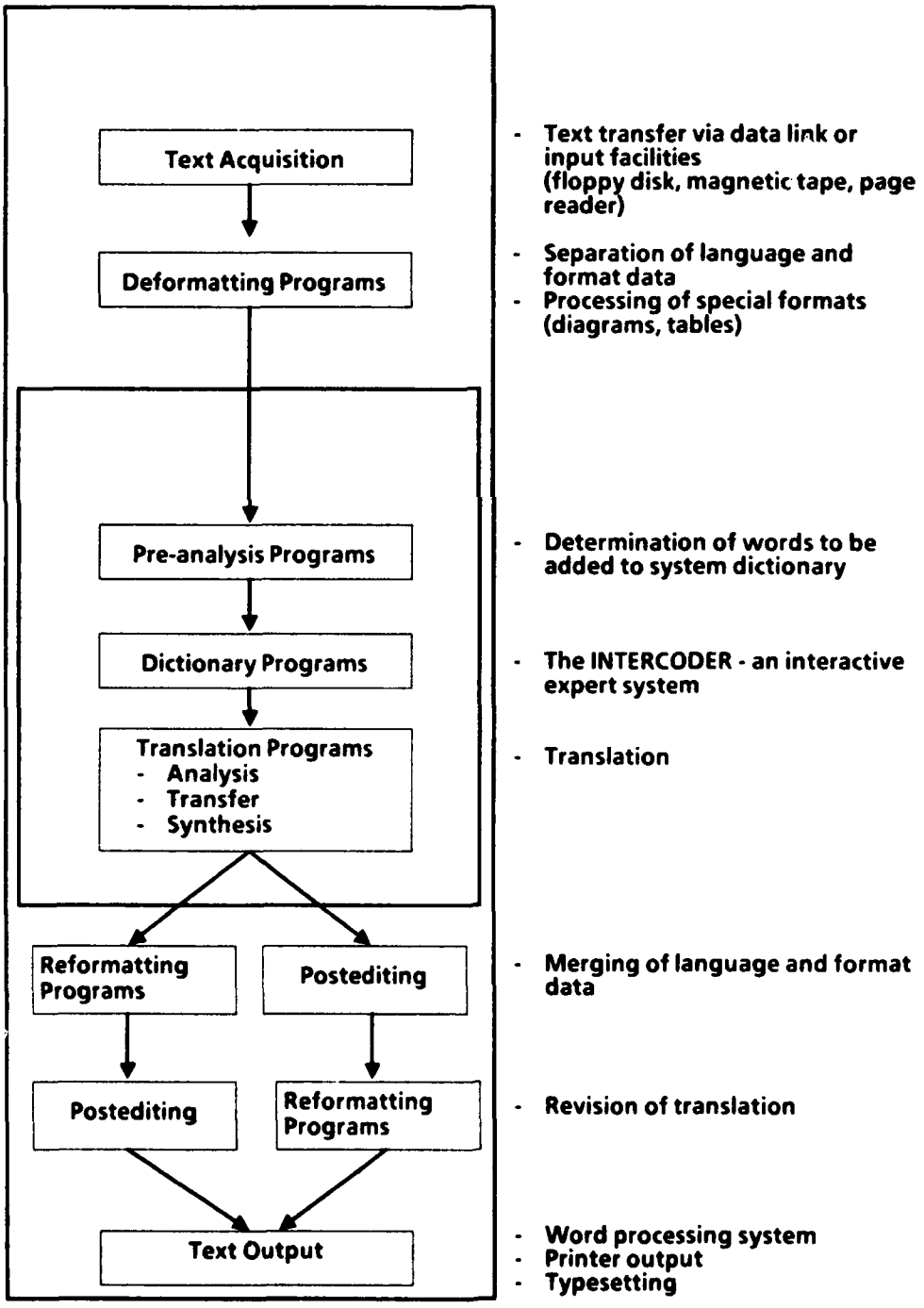

Figure 1

Grammar

METAL is designed in a highly modular way so as to permit the addition of new elements without any major ill effect on existing components. This structure also facilitates the development of new language pairs since analysis or generation modules of a language can be re-used in other language combinations, via a standardized interface (MIR) which maps the results of analyses in uniform ways.

Unfortunately, there is at present no linguistic theory which could account for a natural language completely and unambiguously. Therefore, in the attempt to reach the elusive goal of error-free analysis, a more or less eclectic grammatical system has to be used. METAL is mainly based on a set of phrase-structure rules which are augmented by tests on individual constituents and their interaction.

Two features distinguish the linguistic approach in METAL from that in older systems: recursivity and parallel processing.

A natural language is not a finite system. Consequently it would be quite impossible to write a body of rules which would account for every possible surface structure. In METAL, the grammar rules are recursively applied. To give an example, the possible phrases "black cars", "large black cars", "expensive large black cars" and "shiny expensive large black cars" would not need four different rules. Rather, the multiple application of a single rule adding an adjective to a noun phrase is sufficient.

The interesting aspect about this recursive approach is that the METAL grammar can analyze structures that were never explicitly pre-defined in the rules; in other words, it is an "open" system.

In dealing with the many ambiguities of natural languages, the conventional approach of sequential processing proves inadequate (especially for languages with an almost free word order like German). The problem is not just one of possible different meanings or transfers of individual words, as e.g. a "ball" may denote a social event or a round object.

Greater difficulties arise from the fact that words may instantiate several different word classes, as e.g. "back" may be a noun, a verb, an adjective etc. It is largely impossible to identify the word class, and syntactic function, of a given word without analyzing all other elements in a sentence at the same time. "That" could, depending on context, be a demonstrative pronoun substituting for a noun: "That (= the painting) is awful", or a demonstrative in connection with a head noun: "That painting.." or a relative pronoun "The painting that I saw ...".

In METAL all possible interpretations of all elements in a sentence are collected. Grammar rules are applied in parallel and structures are built. These structures are compared in regard to their probability, and only when a sufficiently plausible structure spanning the whole sentence and accounting for all elements is found, the sentence is translated. This approach may be computationally "expensive" since a lot of data have to be compared before decisions are made, but it seems at present to be the only approach which even comes close to an adequate analysis of natural languages.

Lexicon

METAL operates on both monolingual lexicons and one transfer lexicon for each language pair. The monolingual lexicons contain morphological, syntactic and semantic information needed for the analysis and/or generation of a language - regardless of the "partner" language. The transfer lexicon provides a link from the source language to the target language, indicating in which contextual environment and in which subject field a given source language entry should point to a certain target entry.

The advantages of such a structure are obvious. The extensive grammatical information contained in the monolingual lexicons needs to be stored only once even if a lexicon entry has, depending on context, many different translations in the target language. The separation of monolingual and transfer information reduces storage space and saves coding time. Moreover, the monolingual lexicons can be re-used in other language pairs without modification.

It is virtually impossible to construct a system lexicon containing all the terminology for all subject fields (of which individual users would only need a fraction for their application anyway). Therefore there has to be a provision for a translator to extend and update the system lexicon. For this purpose, METAL contains an integrated expert system called the INTERCODER which supports the coding of lexical entries. On the basis of a set of rules and partial information already contained in the system lexicon, the system guesses at the morphological features and the grammatical behavior of new entries. In most cases, the coding suggested by the INTERCODER is correct. On the average, this system feature reduces coding time by a factor of ten.

Of course, productive application requires a sizeable lexicon. However, an unstructured voluminous lexicon can cause more problems by introducing unwanted ambiguities than would be gained by having extended text coverage. It should also be kept in mind that machine translation systems are intended to translate specialized texts and not literary or colloquial texts. In technical texts, for example, the percentage of general vocabulary is quite limited while subject-specific terminology abounds.

Thus it is advisable to modularize the lexicon and to assign preferences to specific transfers based on the subject area of the text to be translated. The METAL lexicon is organized as follows:

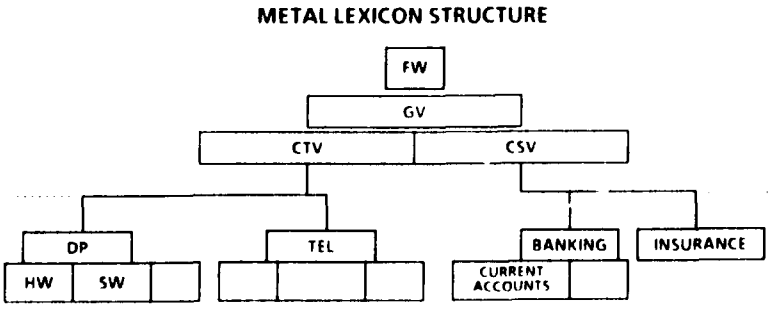

Figure 2

There are modules for Function Words (FW) like articles, prepositions and conjunctions, for General Vocabulary (GV) and for Common Technical (CTV) and Common Social Vocabulary (CSV) organized in a tiered hierarchy. From the next level down, users can define and structure their own modules and tailor them to their specific application. For in-house applications at Siemens Nixdorf, there are for example modules like Data Processing (DP) with submodules Software (SW), Hardware (HW) etc. Beyond that, it is possible to define special transfers for a specific customer, for a specific product or project or for a target country. The German noun "Gehweg" would automatically appear as "sidewalk" in a text destined for the USA, and as "pavement" in a text for British readers.

Before a translation run is started, the modules appropriate to the subject area of the text are set in a parameter file. During the translation run, the most specific modules are searched with the highest priority. If no match is found there, the less specific modules are queried. This ensures that the specific transfer for the subject area of the text takes precedence over more general and inappropriate translations. The modular structure also enables a translator to use METAL for applications in entirely different subject fields without having to load new lexicons.

Additional Tools

Translation proper should not be viewed without its context, and experiences have shown that complementary tools can contribute greatly to productivity. For monolingual applications, the LEKTOR function checks a source text for its readability. Based on the METAL analysis modules, it is able to discern structural properties of a text that make it difficult to understand, e.g. complex syntax or ungrammatical expressions.

Text-based glossaries can be extracted, or the terminology used in a document can be checked against a list of "legal" term. With this tool, the proliferation of unwanted synonyms can be prevented.

A component called DOVER compares different versions of the same document automatically and produces a list of the changes from one version to the next. So it becomes unnecessary to manually check long documents to identify the perhaps small portions that differ - a time-consuming and error-prone task. A lot of the functions that have evolved from the productive use of METAL as a machine translation system are useful not just in speeding up the translation process but in supporting a variety of applications in information processing.

User Experiences

The introduction of a machine translation system into an existing organization requires several steps. First of all, the users must have a clear understanding of what can be expected from an MT system and what is beyond its scope. Inappropriate use will only lead to frustration.

Once the conditions for the installation of a system have been assessed, i.e. translation volume of suitable text types, hardware environment etc, and a positive decision has been reached, the organizational setup needs to be defined. From which sources and on which medium does the translator receive the original texts? Is there a possibility to standardize formatting and layout routines? Can the customers be persuaded to suppress their urge to produce Kantian constructions or similar barriers to quick comprehension as well as translation? Machine translated output cannot be expected to improve on the original text, and badly written originals will not lead to flowing prose in the translated version.

Translators need an introductory training in the system's structure and the tools it provides. Equally important is an intitial training in the different working methods that an MT system requires. Provided that the reader of the target document is not concerned with intricacies of style, the post-editing phase can focus on changing the machine output to an acceptable version with the least effort. A translation could of course be rewritten in various ways, sometimes with a gain in quality but sometimes also with simply a very personal change of style, but without an improvement in quality.

While machine translation is no panacea for all aspects of multilingual communication, the experiences with more than two dozen METAL installations have been quite positive, provided the system is used appropriately. Translators as well as management have to understand that an MT system is not a substitute for highly qualified translators but no more and no less than a powerful tool for them.

One has to keep in mind that during the first few weeks of operation, the translators' productivity will actually decrease. There is an initial overhead of bringing the system lexicon to a level where it covers most of the terminology required. Also, translators have to get used to the different work technique and must acquire skills in lexicon building and system administration.

After this initial period, which may vary from a few weeks to perhaps a year, users have reported considerable gains in productivity and a decrease in turnaround time. Under favorable conditions a productivity increase by a factor of 2 to 3 seems to be a realistic goal. An additional benefit is the consistency of the terminology throughout all documents. Some users view this as a qualitative improvement of the target text which rates at least as high as the gain in productivity.

Moreover, the availability of an operative machine translation system will lead to a situation where many documents which could not have been dealt with in the past, will actually be available in translated form. This will support not just the dissemination of texts, but also the acquisition of information from foreign sources. Integrated with a powerful information retrieval system, METAL could exploit its linguistic ability and extract relevant items of knowledge from multilingual full-text data bases. Here, as with machine translation, the key lies in the sound and sophisticated analysis of natural language.

We should not expect miracles. Design and implementation of natural language processing systems is a difficult and very expensive task, and - from the viewpoint of industry - it is highly improbable that proceeds from the sale of products will pay for the enormous costs for research and development. Therefore further progress in automating multilingual communication will hinge on the realization that work in natural language processing is not simply another product development, but that it opens the door to a base technology which is indispensible for global communication.

END USERS: NEW PRODUCTS AND SERVICES

by

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Introduction

The database industry is young. 20-25 years ago online databases were little more than a dream, and most of us didn't even dream about CD-ROM and multimedia databases. Much has indeed happened in this business since the first databases took off.

The Nordic countries entered the database scene early. In Sweden the SDI service EPOS/VIRA was started as early as in 1967, and in 1972 the first online service, MIC/MEDLARS, was set up in Stockholm, hosting databases mainly within medical disciplines. Both services got users from all the Nordic countries. In the same period online searching at hosts such as DIALOG and ESA-IRS got a start, and several Nordic databases emerged - with various search languages on several hosts in each country. At the end of the 70's online searching was relatively well established in science and technology (incl.medicine). The users were primarily intermediaries in university and research libraries, i.e. scientists and engineers in the libraries. A survey within European countries in 1987 showed that the persons involved in searching were "still mainly scientists and engineers" (1).

End users are today important market groups for database producers and hosts. Much of the growth in database usage has been expected here. Numerous products and services have been introduced for easier and more efficient information retrieval and management, to attract end users.

A wealth of information in databases

As of the number of databases available to users today, the last figures are more than 7300 in "Cuadra". 5300 of them are online databases issued by 2200 producers and available on more than 800 hosts (2). The "Cuadra Directory of Online Databases", which is one of the most used database inventories, listed in 1979/80 the totals of 400 online databases, 220 producers and 59 hosts - the growth since then has been tremendous. The most common databases are the bibliographic, factual and full text databases. During the recent years new types of databases have appeared, with mixed textual or numeric data with chemical structure diagrams, photographs, maps, trademarks, etc. These graphics databases require special equipment for their use. The time of the dumb terminals is behind us.

An inventory of Nordic databases has been produced by NORDINFO/ SCANNET (Nordic Council for Scientific Information and Research Libraries). since 1985. The last edition, 1992, shows a total of about 550 databases, most of them produced in the Nordic countries (3).

There are even more databases available than such directories show. An enormous amount of information is today available on international networks such as Internet. Besides databases there are library catalogues (OPACs), bulletin boards and file collections on computers almost anywhere in the world, linked to Internet. This is an enormous potential for end users, not only for database searching, but for personal contact and discussions using e-mail and listservers. Networks as Internet seem to be one of the major products for end users to get better access to information.

European information

Information about and from the Commission of the European Communities, single market, laws and directives, tenders, information about EC supported research, programmes and projects is more and more asked for. Norway is not a member of the EC, but there is a growing demand for such information, as well as for information about eastern European countries and Asia.

Standardization is more important than ever. European information has to be searched on a variety of hosts, the databases may be in German, French, Italian or other languages, and with different search languages. These are barriers to all users.

NORDINFO has initiated projects to overcome such problems:

The IANI project, which is presented in another paper at this meeting, attempted to produce an interface to access Nordic (and other) databases with one login procedure and one search language.

Another NORDINFO project is the SR-NET-project. The aim of this project is to

- enable the end-users to easily retrieve data from databases while working as if they were on their local database
- improve the knowledge of OSI protocols in general and especially the OSI SR Search and Retrieve protocol.

The project is based on IANI in connection with the SR-protocol, and according to the plans five central information systems in four of the Nordic countries will be connected (4,5). We really hope this project will give positive results.

Information technology developments for end users

Database producers and hosts are steadily offering better products to attract users. During the years there have been a lot of improvements, - sophisticated search languages for the trained users as well as menu driven systems for new users,

and better telecommunication networks has helped a lot. Some technologies have had a major impact on information management in the 80's:

Microcomputers
Gateways and front ends
Higher speed packet networks
Increased storage capabilities
CD-ROMs
Electronic mail (e-mail)
Facsimile transmission
Etc.

Many of these technologies are discussed in papers at this meeting.

In this decade, the 90's, networks and networking seem to be one of the most important tasks. Electronic ways to communicate, send or receive information, on campus as well as outside campus, are relevant services in libraries today. In a technological library this is an easy way to get better contact with users. Parts of the user education and training in library services could probably be on the campus network. I am sure many of our users would find this interesting.

Among database producers as well as hosts and online searchers, much attention has been paid to the process of finding information:

How to select databases
How to search them
Downloading of results and logging of outputs
Artificial intelligence and development of user-friendliness in searching

Searchers have also been concerned about methods for editing and reformatting results before printing and presenting them to end users.

Less attention has been paid to the process of delivery of information, how output from searches can be sent to the end users electronically, and how users then can work further with the results electronically, when writing reports or in the document ordering process. Much of this work is still done by "old methods", where outputs from online searches are sent to the users as printed lists, and users have to type order forms to get the full text documents from the library. Many OPAC systems have now online ordering facility, the same has many online database hosts. BIBSYS, the Norwegian university and college libaries' system has an ordering facility, but still much of the document ordering to libraries is done manually in Norway.

Electronic ordering of documents at NTUB

Use of PCs in the online work gave possibilities to extended user services in our library. Since the late 80's we have logged online searches to harddisks, to let clients choose between having their results respectively on floppy disks, printed paper or sent to their e-mail addresses. More and more clients want to receive their outputs in electronic form. As a rule the search files are kept on our PCs up to 2 months. During this time the clients may contact us with document delivery orders. With our inhouse developed software called BESTILL, we transfer orders electronically from clients files to order forms which the interlibrary loans department uses for handling the orders. The service has been very well accepted by our users.

A further development is NTUB-MAIL, our electronic ordering system, which can be used by anyone who can send e-mail to our NTUB-MAIL e-mail address. Such access have users of the Norwegian academic network Uninett and networks connected to Uninett, Internet users, etc. When orders are coming in, we use the BESTILL software to transfer them to the interlibrary loans department for handling. This service has become quite a success. It has a special link from the SAMPER database of periodicals in Norway, and now more than 20% of orders in SAMPER are going to NTUB-MAIL.

Today 31% of all document orders to our interlibrary loans department are sent by electronic means (total of 70.000/year, nearly 22.000/year electronically).

NORDINFO has just initiated a project for electronic delivery of documents. The document delivery service ARIEL will be tested in 15-20 libraries in the Nordic countries. It requires a microcomputer, scanner, laser printer and ARIEL software on each site and connection via a local network to Internet for the transmission (6). We look forward to see the test results, we have just installed the equipment on our site.

There are today several services for electronic document delivery which look interesting. The RAPDOC project in the PICA system in the Netherlands is a project for scanning of documents and transmission of them via Surfnet, the Dutch part of Internet (7). The various electronic document delivery systems can possibly be interconnected via Internet in the future?

Internet, Cosine, net of networks

It is said that Internet consists of more than 5000 networks in 33 countries. It has more than 1 mill. nodes in the world. It gives us access to a lot of OPACS, directories and guides, and through Internet we may even call up many of the large online hosts at no communication costs. This is an important tool for end users to learn to use databases and collect information from all over the world (8,9).

IXI is a network made specially for universities and research centers in Europe, sponsored by EC Cosine and free of charge. A lot of European databases can be accessed through IXI. CONCISE is the Cosine Network Central Information Service for Europe, a help for users to find out about databases on IXI. Also this service is free of charge. A very useful tool for end users as well as trained searchers to collect information about OPACs and other databases in Europe (From October 1992 the name IXI is changed to EMPB - European Multi-Protocol Backbone).

CD-ROMs

CD-ROM databases are beside OPACs now the most used databases in libraries. CD-ROMs are ideal for end users, free of charge and with user friendly search interfaces. CD-ROM subscriptions are expensive and take a lot of a library's budget, but almost every university and college library has some subscriptions today. CD-ROMs in networks are quite common today, in our library we are now considering CD-ROMs on the university network. In Norway we do not have any bibliographic databases loaded on the academic network as for instance on JANET in England, but that is under consideration.

End user training

I have mentioned above that database hosts, producers and networks are steadily developing systems which shall be easy

to use also for people without special training. Our experience is that end users need some training to be able to do better searches. All searchers need to know how databases are set up and indexed to do the best searching, in online databases as well as CD-ROMs.

At our library we do a lot of such training. An example of which is mentioned below:

Industry in Norway consists mainly of small enterprises. 80% of companies have less than 50 employees, and have about 30% of the employment in the industry in the country. Only about 1% of Norwegian companies have more than 500 employees, these represent about 20% of the total employment in the country. This is not a special Norwegian phenomenon, but in Norway the small enterprises are generally smaller, and the large companies fewer than in other industrial countries. We are in a time with heavy unemployment, and there is a need for development of new ideas in industry to overcome the low employment.

Norway is not a member of the European Communities. An official EURO-INFO- office has however been opened to help industry with information about EC and the single market. An EURO-INFO network which consists of centers throughout the country are helping the local small enterprises. Our library is one of these centers. A special EURO-INFO database project is now going on, where we are analyzing 15 small companies in our region, finding their needs of information, and helping with database searching according to needs.

5 of the 15 enterprises in the region are expected to be end users at the end of the project. The project started last year. It has been difficult to find companies who want to search databases themselves, they are usually so unexperienced with information and library services that they want their searches done by us. We are looking forward to seeing if some of the companies will be "success stories", and eventually to seeing if any of the companies will get positive results out of the tenders searching in the TED database. An export contract for a small company might be very welcomed.

At last I'll point at the importance of end user training in how to search for information. Networks as Internet have given a lot of interest to database and library services - it seems that we get more distance research - users may do library research without having to go to the library.

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THE MODERN RESEARCH ENVIRONMENT

by

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Information Technology and the scientific and technical communities

At first, let us comment on the possibilities as well as the challenges which Information Technology and geopolitical facts and trends present to the user communities in question.

We start by making some observations (claims):

- For every user community, be it chemists, medical researchers, aerospace specialists or what have you, there is a need for better collaboration and more efficient production, exchange and retrieval of scientific documents and other information;
- Information Technology (computer technology, telecommunication, networking, value added services, special purpose software packages) is perfectly suited to assist individual users as well as user communities;
- compared with the potential, user communities have as yet made very little usage of the technical possibilities;
- geopolitically, there is an opportunity as well as a pressure to tie together the scientific and technical communities on a world wide basis to an extent not seen before.

Let us, somewhat at random, make a non-exhaustive list of typical tasks performed by the researchers:

- preparing scientific and technical manuscripts (articles or monographs with complicated structure, sophisticated notation, possibly with multimedia components);
- collecting and organizing information (reviews, papers, pre-prints, patents, datasets from experiments ...);
- communicating with colleagues;
- preparing lectures (slides, audio-visual material, ...);
- retrieving directory information (who? where? interests?);
- accessing special software packages ("number crunching", symbolic manipulation, image processing, statistical analysis, spread sheets etc.);
- publication oriented work (editing, refereeing,...);
- arranging conferences (keeping track of things);
- writing reports, minutes, ... (preparing, sending, commenting, approving, storing).

Considering a list like this, it is realized that, yes, Information Technology can assist the user with each one of these tasks. However, the present picture is chaotic. There is no unifying trend and even within the same type of task (document preparation is a good example), several different, often incompatible tools are in use, sometimes even within the same research institution.

The ideal user community

It is close to evident that initiatives to improve on the situation should be

- user driven and technology dependent

— not the other way round as has only too often been the case. This poses some severe demands on the user community in question. It becomes essential that it is well organized. Depending a little on the field this implies that:

- central bodies representing the community exist, which are able to collect, represent and communicate views and needs of the community;
- decentralized units - either regarding topic, geographical location or special ways of working - are set up with good communicaion channels to the central bodies;
- effective liaison with neighbouring scientific communities and with other organisations which either assist or could assist the community, have been established;
- the whole organisational setup catalyzes a community feeling, hence a responsibility and interest for the well being of the community among all its members.

The ideal user community as described above does not exist! And the situation becomes worse if we add a demand that the community should either itself be well to do or else be able to attract sufficient financial resources to support its community oriented activities. The community to which the author belongs - that of mathematicians - is reasonably well organized but among the rather poor in the scientific spectrum.

The ideal user platform

As already indicated, the situation today is rather chaotic with many highly varied tasks and no element of unification. What is needed is the creation of, what may be called, the users platform/ research environment/ workbench/ or, perhaps the most suggestive term, the researchers frontend (- frontend to all the goodies Information Technology can provide).

What we are trying to identify is a software-oriented tool connected in a suitable way to the telecommunications- and networking infrastructure.

To reach the desired degree of unification, the ideal research

environment must present the same "face" to the user, independent of the particular task, and also, it must exchange data according to a generally accepted data model. We may formulate these two demands as:

- a demand for a common user interface across the various applications;
- a demand for a common data model i.e. for accepted or de facto standards.

What we have in mind is a software based tool - the user's platform - accessed from the user's personal computer or, much better, from his workstation or X-terminal. You must recognize that:

- a software oriented solution as indicated to the needs of the scientific user communities is completely dependent on a well developed networking infrastructure, without which an open interaction and exchange among researchers is not possible.

The reason why we have not focused firstly on the networking infrastruc ture is that, though important work is still going on, by and large, the basic technical problems have been solved, and the infrastructure has been established. This applies to the Western world. Also, the work in the area of basic networking is going on anyhow, without much interference of the researcher. Of course, in some regions, specifically in Eastern and Central Europe, and in the developing countries, much work still needs to be done (but based on known, well proven technology).

Many will disagree with the view maintained, and could point to new technologies being developed which will enable, say real time processing and communication of images or video. I do not question that these activities are sensible, only the balance of activities. With a vast unrealized potential which could significantly improve the research environment for millions of researchers and technicians around the world (for others too, in fact!), it is essential that the emphasis for this decade will be on bringing services to the users, tailoring them to their needs.

In schematic form, the ideal user platform looks like the one indicated in Fig.1 (adapted from the Euromath brochure):

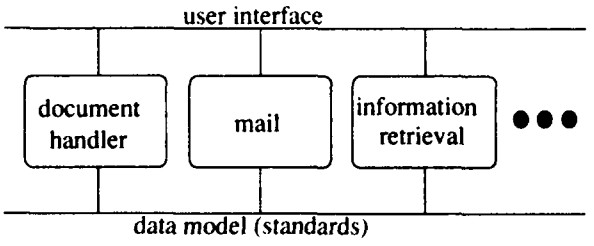

Fig.1 The ideal user platform

Much work has been done on user interfaces. A key observation is that very few commands are necessary, as the same commands may be brought to apply to different applications. For instance, efficient usage of commands as "get", "copy", "paste", "delete", "move", "find" and "undo" will bring the user a long way, if only the underlying design is well thought out.

To exemplify further, if a query document is pasted to an information retrieval service, the desired search - possibly decentralized, invisible to the user - is carried out, and the result may be copied to a specific document, which may then be sent (say "posted" to the out-mail box) to a colleague.

In the area of standardization, much work still needs to be done in order that data can be exchanged between different applications and in order that data can be communicated in a WOSIWOG fashion (What One Sends Is What Others Get - as a nearby example, think of the problems we have communicating the many special characters in the European languages).

The user interface and the data model should be publicized, enabling manufacturers to develop new applications as the need arises, and adapt them to the users environment. In this way, the architecture outlined in figure 1 will be open and extendable.

The ideal user support organization

Two key objectives are:

- every user should be able to receive support "close" to him or her and in his or her own language;
- the user support organization should be able to keep track of trends in the user community, to identify basic problems and to provide input for the continued development of the research environment.

The form of user support (with a blend of electronic support, courses, hardcopy documentation etc.) and its detailed organization (say, with several hierarchical levels) will depend on the user community in question.

As many (perhaps even all) applications and services provided to the users are dependent on a data network infrastructure, it will always be important that support centres have access to, and some understanding of these services (e-mail, file transfer, remote login etc., and their relation to various technical protocols and telecommunication techniques) Very often, the providers of basic network services are the only links end users have to support. This is unfortunate in most cases. There is a great need for support centres that can bridge the gap between end users and providers of basic network services. In conclusion, then:

- user communities must themselves organize support for their users.

Experience shows that it is very difficult to establish efficient user support. Quite a few initiatives attempt to provide support for the "general" user. Though not without value, more directed efforts are sought for.

The significance of structure

One way of viewing a modern research environment is as a tool to allow manipulation of structured documents. Here "documents" should be interpreted in a wide sense. However, to illustrate the point about structure, we shall only have 'normal' documents in mind which are intended for publication in a scientific journal, proceedings volume or the like.

Many platforms for the production of such documents are very much layout oriented, in fact typesetting systems. It is highly advantageous to separate structure from presentation. An important generic tool for the creation of structured documents is SGML, Standard Generalized Markup Language. In this language, you may define specific document types (via

DTD's, Document Type Definitions). For instance you may define a type "article". This type will surely contain elements as *title, author, abstract, sections, footnotes, references* and many other.

A key feature about structure is that it opens up for flexible use of your documents. For instance, a focus on structure often makes it easier to modify a document. An article can be modified by sticking in an extra session with automatic renumbering of other sections, equations, references etc.

Equally important, structure does not fix presentation beforehand (though there may always be provided a default presentation). Thus, if you want to "prepublish" your article in your institute preprint series, you send it to the person in charge who makes sure it is printed using the preferred, presentation rules of your institute. And when your article is published in a scientific journal, it is printed using the presentation rules and layout, typical of that journal. In both cases, the same structured document was used as input.

Some points in relation to the above scenario may be pointed out:

- structure is necessary to allow flexible and multiusage of documents;
- extensive standardization efforts are necessary in order to agree on specific types of structure (e.g. DTD's under SGML);
- whereas one should strive for few standard types at the general level, one should not prevent the definition, of local user defined standards;
- detailed rules governing presentation of documents should always be left to specialists, not to end users.

Without attempting to go into detail, we point to some of the already active work in standardisation of DTD's, such as Computer Aided Logistics Support (CALS), Documentation of Military Equipment (US DoD's), and the general ISO guide to DTD's (ISO TR 9573) (containing also a fragment of a DTD for mathematics).

May I, as a side remark, express my irritation over the detailed instructions to AGARD authors regarding the preparation of their manuscripts (instructions that I may well refuse to follow!). This is none of our business and could have been avoided if the structural viewpoint was already prevailing. If it is of any consolation to AGARD editors, such detailed instructions are quite common nowadays (I received 3 different sets of instructions over the last few months!). A lot of work is going on in this area (led by ISO, the International Standards Organization, AAP, the American Associations of Publishers and others) and in a few years there will be no more irritated authors! [Added remark: In all honesty, I should report that the contributors to the present AGARD publication were, after all, allowed not required to obey detailed special rules.]

Networked Information Retrieval

Many of the basic network services, such as e-mail, file transfer, remote login etc., are well known and I shall not comment on them. Instead, I point to the area of NIR, Networked Information Retrieval. Such tools (WWW, Archie, Gopher, WAIS and quite a few others) are under extensive developments right now, and these tools are destined to play a prominent role in the design of research environments. (Interested persons should consult one of the ongoing working groups on the NIR tools; I recommend contacting either RARE or the Internet Society, cf. Note 2 below).

In fact, the NIR tools are already operational and they open amazing horizons with online efficient and decentralized information retrieval or with database searches penetrating the networks world wide, yet provided to the user in a transparent and often quite user friendly way. A key point about these services is that they permit that information is kept and updated "on location" where there are people interested in providing the information and in maintaining it properly.

For the design of research environments, one may then concentrate on selecting information servers of particular interest to the user community in question, and providing easy access to those, or in assisting the users in producing useful data queries. There is no need to create yourself a huge reservoir of information. The consequence of this development may be the disappearance of database hosts who do not have responsibility for actual maintenance of data.

Another consequence of the development may be emergence of electronic journals where the individual articles reside decentrally. In order for such journals to present themselves to the users with an identity of their own, and with ensurance of high quality authentic papers (which have undergone the process of peer review) it appears that further development is still needed. (A good starting point to acquire insights in this field is the book 'Structured Documents', edited by J. Andre, R. Furuta and V. Quint, The Cambridge Series on Electronic Publishing, Cambridge University Press, Cambridge, 1989).

Euromath and EmNet

In this section, we shall look at activities directed at the mathematical community. At first, it may be remarked that compared to neighbouring sciences like physics and chemistry, mathematics is a small science (with about 50.000 active researchers world wide). Mathematics is highly fragmented with many specialized subjects. This implies that active mathematicians have to exchange information and ideas with colleagues situated far apart.

Compared to sciences having a strong experimental context, one may say that mathematicians have relatively modest needs, e.g. in general, they do not generate massive data sets that needs to be accessible on-line by the community.

As the community is relatively well organized, it lay nearby to siege the opportunity resulting from technological advances and geopolitical changes, and tie the community together by creating the necessary research infrastructure.

The possibilities of attracting funding from the EC, resulted in the formation of a European project, Euromath. The organization behind this initiative, the European Mathematical Trust (EMT) has formulated the objectives as follows:

> OVERALL EUROMATH OBJECTIVES (from Euromath Policy Document, November 1989): "To provide European mathematicians with a shared, enriched, computing environment tailored to those tasks which arise frequently in their research work (such as exchanging information and ideas, interrogating databases, manipulating symbolic structures and editing complex documents). To stimulate and greatly enhance collaboration and exchange among individuals, not only with the obvious direct benefits but also with the indirect one of

nurturing the rising self-consciousness of the European mathematical community."

The present status has recently been summarized by EMT as follows:

"Since 1987, the pan-European organization, the European Mathematical Trust (EMT), has worked to establish a modern research infrastructure for the benefit of mathematicians. The result today is a human network in the countries of the European Community and EFTA, and the development of a central software tool which is called the Euromath system. This concept was presented and the software released on the occasion of the first European Congress of Mathematicians in Paris in July 1992. The human network, the Euromath System and the interplay obtained by exploiting modern communication technology constitute the Euromath Network and services (EmNet)."

Though the first Euromath subscriptions have been taken up, the spread of EmNet to a wider part of the community will not take place until next year, following the release of further developed versions of Euromath software.

Those of us engaged in Euromath are convinced of its potential, but it will take another 1 1/2 year from now until we know if the users will accept a new modern concept for collaborative work and research assistance. We are convinced that the critical factors will be promotional efforts, user support and access to sufficient financial resources, both for the central project and at the national or regional level. It should be of great interest for others to follow Euromath and EmNet. Within mathematics itself, various contacts have been established, notably to organizations in Europe. Among the contacts outside of Europe, the collaboration with the American Mathematical Society (AMS) deserves special emphasis because of joint efforts to create standards for the representation of mathematical documents (in particular mathematical expressions).

Collaboration with Central and Eastern Europe

The impact of the changes in C&E Europe on the mathematical community has been significant. We all see huge difficulties but find that we have to do something - and the optimists see a chance to effectively integrate C&E European mathematicians into the entire community, and establish conditions that will strengthen their position (prevent brain drain...).

At the general level, we mention the programs launched by the Commission (TEMPUS, PHARE, COST) which to a great extent, especially as far as TEMPUS is concerned, have been taken up by the mathematicians. Special initiatives by the Nordic countries directed at the Baltic States are also useful. More concretely, we mention special initiatives by the European Mathematical Society and the American Mathematical Society as well as a number of individual universities.

Also Euromath - EMT as well as EmC, Euromath Center in Copenhagen - have been active. The rationale behind such efforts, apart from the purely human motivation, may be illuminated by citing from a recent EMT document:

"The mathematical sciences occupy a strong position in C&E Europe. Mathematics is deployed in support of many experimental sciences as well as being advanced in its own right. To date mathematics in C&E Europe has not been technology dependent. However, with the advent of modern information technology it is becoming a prerequisite for all scientists to have access to a research infrastructure based on computers and networking. This situation represents a challenge for C&E Europe. How can they maintain their position in mathematics now that the "queen of the sciences" is becoming technology dependent? With the growing trend for other disciplines to become more mathematically based this challenge becomes more important.

The situation also presents an opportunity: because of the strong mathematical knowledge base, it appears easy from a logistic point of view to secure and strengthen significantly the position of mathematics in C&E Europe. All one has to do is to provide the proper technological frame work. (This is clearly an over-simplification!). But important work has already been done, and the basic computer networking and telecommunications infrastructure is soon expected to be adequate or close to adequate in some regions of C&E Europe. This allows for the introduction of modern software tools and the utilization of relatively sophisticated value added networking based services, especially designed to meet the needs of the end users.

The strength of mathematics in C&E Europe is matched by a similar strength in Western Europe. Inevitably there has been duplication of ef fort because of lack of communication. There is now a strong wish to integrate the entire European research community in mathematics.

"...Without proper facilities for networking with Western colleagues there will be a growing temptation for young C&E European mathematicians physically to relocate to obtain such facilities in order to give themselves the necessary environment to remain at the forefront of their disciplines..."

EMT and EmC wish to launch further projects in C&E Europe. As opposed to the major Euromath activities, directed at Western Europe, one must pay special attention to the less advanced networking infrastructure and the less advanced computing environment. Thus, the ground must be prepared before EmNet can spread to our colleagues in C&E Europe. Preparatory work has already been done with very satisfactory results. Thus centres of networking and computer knowledge has been established in Bratislava, Brno, Praque, Budapest (two centers) and Sofia (work not complete). In these efforts, Cocom restrictions have been a major hindrance. In particular, these restrictions may prevent proper connection of workstations to Wide Area Networks.

Our experience may be summed up as follows.

- For C&E Europe, special attention must be given to certain basic infrastructure components (telecommunication, networking, computing);
- training related to the new technology must take place;
- observing the above points, activities in C&E Europe are often received with greater enthusiasm and qualified engagement than is the case in the West;
- The low salary level of researchers in C&E Europe is a constant threat to establishing stable conditions and in maintaining the high level of mathematical research in C&E Europe;

- Cocom restrictions still impose limitations in C&E Europe, for work in the academic sector;
- It is possible, and highly recommended, to bypass yesterday's technology and introduce at one go today's sophisticated technology in the areas of networking, telecommunication and computing.

All in all very positive statements. The team behind Euromath and EmNet hope that it will be possible within too long, in collaboration with others, to extend our activities to other regions of the world, especially to the Developing countries. This will present major problems but the hope is of course, that benefits to the academic communities resulting from improved technology and from (hopefully!) positive geopolitical changes will reach all parts of the world.

NOTES

Note 1. It is the intention to make the manuscript available, also as a file retrievable from the gopher Server at EmC (Euromath Center, Copenhagen; login as gopher on gopher.euromath.dk).

Note 2. The following material was put on display at the AGARD meeting:

1. RARE Technical Report 1, User Support and Information Services in the Rare Community, 1992
2. INTERNET Society News, Vol. 1, no. 2, 1992
3. Guide through SURFnet, 1991
4. Euromath (a glossy brochure)
5. Euromath Bulletin, Vol.1, no. 1, 1992

re 1: The report will be updated on a regular basis and is available via ftp. For more information, write to the RARE secretariat (rtr-info@rare.nl) or to the chairman of RARE WG-ISUS (Information Systems and User Support), Jill Foster (jill.foster@newcastle.ac.uk).

re 2: I recommend in particular to have a look at the article(s) dealing with information systems. For more information write to the Internet Society (isoc@nri.reston.va.us) or to Joyce K. Reynolds (jkrey@isi.edu).

re 3: If you are interested in receiving this publication, you should contact Surfnet (info@surfnet.nl). The material is put on display to show an example of services and User Support provided by one of the national academic network providers. Surfnet is chosen as they are quite strong on user support. It is stressed that this applies to a few others - not to all - of the European academic network providers.

re 4 and 5: These items bear witness of activities directed at a special user community, mathematicians. Item 5 gives the more precise and detailed information whereas item 4 in a few pages stresses key issues of "Euromath" which to a great extent must also be taken into consideration by any other user community exploiting IT and modern networking. Further information can be obtained from Ian R. Stone, EMT secretary (fax +44 227 452 196), Mika Seppälä, EmB chief editor (ms@geom.helsinki.fi) or the author, chairman of EMT and EmC (topsoe@euromath.dk).

THE MANAGEMENT OF CHANGE : IMPLICATIONS FOR THE INFORMATION PROFESSIONAL

by

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Introduction

By way of an introduction, let me start by saying that a) I am delighted to be here, and that b) my background is very different from yours. Most of my career has been spent in the public sector - the Civil Service, higher education and most recently local government. For a number of years, I also worked for the Industrial Society, the UK's largest management training consultancy and in the last six months, I have established my own management and training consultancy called Hudson Rivers. This, therefore, is my first brush with the defence industry, although when I was in HE, I was involved with scientific and technical information.

However, I do have some experience of both managing change in a variety of settings and also of helping others to manage change in their own organizations, and it is that which I wish to talk about today. I should stress that most of my work is in the UK so if I tend to use UK examples, I apologise. I hope that in the discussion which follows there will be an opportunity for examples from other countries to be provided.

In the paper I would like to address some of the drivers for change in the information world and look the impact on the information professional. I thought I would conclude with some of the concepts which will be essential to our survival and I hope prosperity in the future.

Pressures for change

All organizations are facing considerable pressures which have led to unprecedented change. According to the American management guru, Tom Peters(1), the only certain thing is that change is here to stay, and if anything, will become more rapid and probably more traumatic in the future!

The changes we are facing in the information world include our clients' expectations and demands. In the UK, expectations of public services have been deliberately targeted through the introduction of the Community Charge, the Citizen's Charter and the growing emphasis on quality. In your own organisations, clients are likely to be more demanding and at the same time, more discerning. This is partly because our customers have become more proficient at using the technology that has been our prerogative up to now, and also because information producers are making their products much more user friendly marketing them at the end user.

Technology is also making the traditional approaches to information retrieval obsolete so that there is an increasing reliance on electronic information and document delivery rather than hard copy collections. The move from the visual to the virtual library has a number of implications which I will discuss later.

At the same time, the defence industry is contracting and looking for major efficiencies. Only last month a 20% cut in the Defence Research Agency in the UK was announced with the loss of more than 2000 jobs. As well as reducing budgets per se, this creates pressure on all of us, to provide services that are competitive and represent good value for money.

Implications of the changes

Technology

You are far better qualified than I to discuss the impact of the technological developments although I sometimes wonder whether we are really ready to cope with the potential that the technology permits. Peter Drucker in a recent text (2) stresses that we need to ensure that the human side of technology is considered as well as its information potential. I was interested to read in a very recent report on a visit to academic libraries in the USA (3), that the technology now enables students to locate, order and retrieve information at their individual work stations. At present, the most heavily used information is the weather report, but I am sure things will change!

The virtual library/information unit will certainly mean a different pattern of stock - moving from collections that are there 'just in case' to a service that is 'just in time'. This is likely to mean an emphasis on document delivery rather than hard copy and a substantial reduction in the number of journals and reviews we subscribe to. Already several universities in the UK are proposing to shift a major part of their budgets from acquisitions to document delivery. However, I understand that some of the publishers are having doubts about document delivery and the real impact on academics and their need for publications has not yet been investigated. I shall therefore be interested to see whether the change will be quite as rapid as some predict.

I believe that the combination of the potential of technology and the need to reduce expenditure could have several consequences for the information profession. Firstly, it could lead to a rationalisation of a number of information units into a few centres of excellence. Instead of an information service on site, researchers would call up the appropriate centre and order the information they require. Already in the USA, the secondary campus which relies on a virtual rather than a visual library is a reality and this concept could be easily be extended to your own circumstances.

Secondly, I pose you a question which you may wish to develop in the discussion. Does the potential of technology, the move towards end user searching and the need for reduced resources mean that the information specialist will become obsolete? Or is there a new role for us - to become information intermediaries or advisers i.e. adding value to the information already retrieved by researchers. I should warn you that many publishers see this as a valuable market for them so there could be considerable competition.

Efficiency

This was the buzzword of the 80's and by the look of it, in the 90's there will be even more emphasis on cost effectiveness and market forces. In the UK these changes are leading information units and services across all the sectors to look at different approaches to service provision. In particular, most services are facing reducing budgets, often at a level of at least 10% per annum. This emphasis on downsizing or doing more with less has severe implications both for the services we offer and the way we offer them.

Many information services have evolved in response to different needs over time and have ended up offering a miscellany of services and facilities rather than something which is planned and systematic. One important consequence of reducing resources is the need to identify which are the core services which must be developed and those which are no longer appropriate. We can start to do this by surveying our clients' needs and by analysing the competition. We are then faced with difficult decisions about services which we may feel are peripheral but which may also have powerful advocates and supporters. Options to consider include unbundling, outsourcing or sub contracting such services to external agencies, ceasing them altogether or relocating them to another provider. Whichever we choose, we are almost certain to upset someone who regards the service as vital so that sensitivity and good political skills are important.

If we do sub-contract some of our services, again the role of the information specialist changes to that of client rather than provider. This means developing a thorough specification for the service after consultation with our customers, monitoring and managing contracts and service level agreements, imposing penalties for default and negotiating amendments as circumstances change.

Charging for services

Another option in the current economic climate and one which many information services have already adopted, is charging for all or some of their services.

There would seem to me to be several options all of which have significant implications for the way we operate.

1 Everything remains centrally supported although this is probably naive and unrealistic in the current economic climate

2 Core services remain centrally supported, everything else is charged either at cost or to make a profit

3 All costs are recharged to clients

4 The whole service is competitively tendered and possibly contracted out.

Whichever option is chosen, cost transparency i.e. knowing the full cost of the services you provide is vital. It is important to include all costs including recharges as these can make a considerable difference. For example, the British Broadcasting Corporation is about to introduce a scheme called Producer Choice where the total cost of the library and information service will be devolved to individual producers. They will then have the choice, either to use the internal services as they do at the moment or to go elsewhere. At present, the BBC's library/information service costs c.£3 million per annum. When overheads i.e. the cost of space, recharges for central services etc. are added on, the cost soars to over £5 million thus doubling the cost to the customer and becoming less competitive. At present, there is little possibility of relocating to reduce costs so any economies have to be made in staff or services thereby reducing the attractiveness to the customer even further.

If you do contemplate charging out, as well as knowing your costs, you will need a very detailed and accurate picture of your clients and their current use of your services. This helps you to estimate the potential use and therefore the unit cost of your service and enables you to demonstrate the use in proposals to and negotiations with clients. You will also require thorough information about the competition - to determine your USP [unique selling point] and to see if you are really competitive. You may need a business plan to convince your political masters [usually in the guise of a management consultant] that your proposals are viable and you must develop even better marketing, selling and negotiating skills in order to convince your customers that they need to use your services.

If the worst happens and you have to tender and compete with others for business, costs and charges become even more important. Westminster City Council in the UK has recently contracted out all its library services and has stipulated that the cost per book issued must not rise above a certain amount. When conditions like these are imposed, no one can afford to be complacent about their customers and risk losing them.

Charging external customers

Charging external customers is another option already adopted by many information services. Depending on the services you provide, this can generate a considerable amount of income, but it can also distort the services provided. Also raises a philosophical objection for many information professionals who feel that information should be freely available.

Structural and resource implications

With reducing budgets, many information units are facing the prospects of convergence i.e. merging with other departments to form larger and more diverse units. This economy of scale approach is now very common in the UK and is leading to some strange alliances. For example, my previous job in local government included responsibility for the library/information service, a conference centre and catering! According to Tom Peters (4), the organisation of the future will be drastically reduced in size and it will be the effective management of these multi - discipline project teams and task groups which will be the crucial element in an organisation's success.

Managing upwards

In the ever changing political and social climate, understanding and influencing the organisations in which we work will become even more important.

The successful information professional of the future will take

the initiative on strategic and corporate issues. For example, at Glaxo, the information service has taken the lead on developing the organisation's information policy. This has put the information service at the centre of the information process thereby raising its profile and status within the organisation.

Other information services have used the interest in and development of quality assurance to raise their profile. John Brockman gives a useful overview of examples in a recent article (5). He mentions information services which have taken the initiative and gained accreditation in their own right and have thereby demonstrated their importance to senior management. There is also an example [in the Health Service], where quality accreditation has enabled an information service to argue for more staff.

Brockman's article also refers to Total Quality management and includes two examples from the information world - DTIC and NTIS in the USA which have been publicly recognised for their approach to quality.

Other aspects of managing upwards include the development of acceptable indicators of performance which will help you to demonstrate effective use of resources. Similarly, encouraging our customers to assign a financial value to the information they use is very difficult, but is increasingly important in making a case for resources.

The management of staff and self

TQM etc. brings me to my two final points, the importance of managing staff in a time of rapid change and the need to manage ourselves. Redundancies and reductions are very unsettling for staff and mean that the information manager of the future must pay even more attention to issues of communication, motivation and involvement in order to develop quality services. We need to be selecting staff, not only for their academic/subject expertise, but also for their ability to deliver service excellence. We must also help our staff to develop their own skills, competences and confidence through regular training and techniques such as counselling, coaching and mentoring.

The new patterns of service we provide will mean that we may have to adopt different ways of employing staff in the future. Charles Handy (6) has suggested that organisations will become shamrock shaped with a small core of permanent staff and a larger pool of other staff who will be employed as and when they are needed. Many information services in the UK have already adopted this model, using contract and temporary staff to cover busy periods, to provide specialist services which are uneconomic to provide in-house or just to allow greater flexibility.

The improved technology has also allowed companies such as British Telecom, ICL and F International who pioneered new approaches such as teleworking i.e. working from home. According to the Henley Centre for Forecasting, by the year 2000 almost half the population in the UK will be teleworking. However, Kinsman and others (7) stress that such a diverse range of staff present a major challenge in the future as they demand very different management and communication techniques. ICL and F International have both established complex communication structures to ensure success and pay great attention to supporting staff who are distant from work.

Managing self

Finally, management of the processes described above means that the management of self is also critical as it underpins all the other aspects. Self management includes the need to keep our own skills and knowledge up to date, but also involves taking responsibility for ourselves and our career development as well as offering support to others.

How does the information specialist develop the necessary skills and confidence? There are many courses such as those offered by the Library Association and TFPL in the UK. There is also a growing emphasis on Continuing Professional Development which encourages the individual to continually upgrade their skills and experience and suggests a variety of approaches including secondments, project and task groups and professional and voluntary activities. If we are able to maintain our own skills and confidence, we will, I think, be well qualified to deal with the changes I have mentioned and the ones that I have not.

Conclusion

In this paper, I have tried to address some of the issues which are affecting information professionals within the defence industry today and perhaps more importantly to identify some of the implications for ourselves and our work.

Thank you

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FORECASTING AND PLANNING FOR CHANGING PATTERNS OF SCIENTIFIC AND TECHNICAL COMMUNICATION (STC)

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SUMMARY

There are many changes taking place today in the methods and conduct of research and development. These changes have impact and are impacted by the methods of scientific and technical communication. The rapid advances in information technology (computing, telecommunications, and user interfaces) is a root cause of much of this change. The paper will begin by setting the stage with an overview of some issues, statistics and conclusions about changing patterns in scientific and technical communications system. It will then review plans and strategies of nations and major organizations that have been put forward to deal with the changing nature of the information infrastructure and system. Highlights from the following countries will be included: the United States, Germany and Japan. For the United States, a more highly focused review will be made of areas of interest to AGARD. This will include directions for the NASA Scientific and Technical Information Program in the United States. Responses to the management of changing conditions will be highlighted throughout the paper. In conclusion, comparisons among strategies as well as the relationship between strategies and the fundamental changes in research and development communications will be made.

1. THE SCIENCE AND TECHNOLOGY ENVIRONMENT: ISSUES AND CAUSES OF CHANGE

Science and Technology today is in major transition. The changes taking place have impact and are impacted by the methods and tools of scientific and technical communication. Just to set the stage for our thinking, the following quote seems appropriate:

> Five years ago, right after the start of the personal computer revolution, industry experts observed that if the automobile business had developed like the computer business, a Rolls-Royce would cost $2.75 and go three million miles on a gallon of gasoline. (Fortune Magazine, 1988, p.43)

This paper attempts to 1) Discuss the major issues in STC to form a context for forecasting and planning, 2) Provide some statistics about the current status and trends in STC, 3) Discuss some national strategies that have been documented from various parts of the world: U.S., Germany, and Japan, 4) Briefly discuss some developments in the NASA STI Program as a specific example of planning for aerospace information in the context of the paper, and 5) Make some observations and conclusions regarding forecasting and planning for changing patterns of scientific and technical communications.

My starting point for this discussion of Forecasting and Planning for Changing Patterns of STC are two recent studies in which the author has been involved. These deal very broadly with the current context and issues of STC.

In 1991, the U.S. National Science Foundation funded an "Assessment of Scientific and Technical Information Dissemination in the United States." (5,6,7) The first phase of that study was to 1) find quantitative measures for assessing trends and directions, and 2) to identify issues in STI dissemination. Two major interests areas were technology and international aspects. In 1992, the Library of Congress funded a study to develop a Topology of Science and Technology Information Systems. (2) As part of this study, focus group sessions with scientists, engineers, as well as information professionals were held to think broadly about what this diverse group of stakeholders consider as major STI systems as well as issues relating to the development of these systems.

Although much of the data from these two studies represent U.S. perspectives and statistics, the trends and conclusions are supported by reports from other countries and can be generalized to scientific and technological communication world wide.

The study of issues outlined over 40 issue areas. In the context of forecasting and planning, these issue areas become fertile areas for scenario and planning assumption development. The solutions to these issues are likely to be where change will take place. The categories of issues are given in the Appendix of this paper. These were arranged under the following major issue groupings:

- Information Technology
- Content & Access
- Policy /Structural/Institutional
- Legal/Ethical
- Attitudinal/Behavioral
- Education/Training
- Economic/Marketing
- International

In further analyzing these, a smaller set of issues emerged that seemed to be the root causes. These were:

- basic changes in structure of science itself
- increasing commercialization & marketability of science

- lack of coordinated information policy and federal STI leadership
- advances in technology
- growth in volume of information

1.1 Basic changes in the structure of science itself

Historically, science has gone through a series of re-orientations from a disciplinary structure to a mission orientation and to an interdisciplinary, intermission, problem-solving orientation. As each new orientation evolves, it does not replace the previous one, but it increases the complexity of the inter-relationships among researchers, programs, and institutions. To further compound the increasing complexity of science per se, there has been a blurring of boundaries between science, social science, politics, marketing, and ethics. Politics is increasingly concerned with scientific issues and science is becoming increasingly more political. Issues of copyright, privacy, secrecy, and vulnerability are issues that come to mind. There has been a trend toward big science and international science where we see the development of such projects as the conducting supercollider, mapping the human genome, the space station, and understanding the problems of global change. Through all of this, there has been a trend toward specializations in science with new disciplines. At the same time, there are increasing requirements for linkages and interactions among the specialties. All of these forces are changing the nature of scientific organization and the methods of scientific communication and collaboration.

STI is an integral part of the scientific process and it is intimately tied to and reflects the sociology of science and its changing nature. A 1978 report by Arthur D. Little to the National Science Foundation identified three eras of information systems. (8) It discussed the evolution from disciplinary-oriented systems to mission support systems and the need for the development of scientific, technical, and societal systems to reflect the changing nature of science and its impacts. The needs of our age were seen as applied to crisis management and rapid decision making. The driving forces were both technological push and user pull. More recently, a fourth era has been identified which may be called that of "personalized information systems". Era IV is highly technology driven and has gained force with the proliferation of personal computers and workstations. It is also driven by the pressures of too much information and an increasing inability on the part of the user to find that which is relevant and timely. Use of such techniques as artificial intelligence, expert systems, and visualization are key elements in future systems planning.

1.2 Increasing commercialization & marketability of science

On the business side of science, scientific output has increasingly become a marketable product. This and other factors have been changing the reward structure for science. Money has become a tradeoff for the more intrinsic scientific rewards of discovery. It also changes the time perspective of scientists from long term to short term thinking. This time perspective has been linked to the differences in information seeking behavior and information use. It has also been considered with regard to economic and market issues such as willingness to pay for information. When time is money and science is business, more can be spent on STI than when science is academic and long term. Traditional pressures for publishing are now mitigated by requirements of confidentiality and proprietary results in cooperative initiatives between government and industry for the purpose of technology transfer and commercialization. All of these considerations need to be incorporated into new systems design if our STI systems are to serve user needs.

1.3 Lack of coordinated information policy and federal STI leadership.

This is a U.S.-based issue and will be discussed under section 3.1 below.

1.4 Advances in technology

In the Information Age in which we live, advances in information systems and technology have also been causal agents in changes in the way science is done. Electronic communications and publishing have changed the nature of invisible colleges. Preprints and preliminary work can now be broadcast broadly over networks. Ways to establish priority of discovery are changing because of these communication capabilities. They also have the potential to change the whole structure and economics of publishing and thereby to create issues of peer review practices, funding, and pricing. For example, what will replace the accepted method of page charges in journals to keep scientific communication economically viable? Capabilities in supercomputing have opened the field of computational science. The techniques of visualization may open up new methods of synthesis, analysis, and discovery. This will create needs for information professionals and indeed scientific professionals with different skills and responsibilities.

During the Library of Congress focus group sessions noted previously, one of the most significant observations that emerged was that the reason it was difficult to come to a clear picture of a model of STI is because we are in a state of transition that will soon lead to a paradigm shift in technical communications. That shift is driven by the advancement and application of new information technologies including computing and telecommunications. Figure 1 portrays the concept of the paradigm shift graphically as a model for developing future strategies in STI management.

We now have a dominant, traditional STI system that is based on print and interpersonal communication. The technology envelope is changing so rapidly and exerting so much pressure on the traditional systems that the paradigm is in the process of shifting to an electronic world. A few significant observations may be made about the future which should impact strategic planning regarding S&T system development:

1) The formal and informal systems as we have known them in the past are being turned upside down. Major high speed networks are turning the old invisible colleges into collaboratories where all of the work could be documented on the networks through e-mail and file transfers. Fully electronic information life cycles potentially make data part of a formal and reasonably accessible system from the time of creation to its analysis, dissemination, and use.

2) The traditional ways of thinking about systems such as primary, secondary, and tertiary will lose relevance because secondary sources such as abstracting and indexing systems are basically finding tools. Primary material is the actual full text. These distinctions will blur in a fully electronic world.

3) Expanded further, the traditional systems that have been based on logical versus physical access, as well as the distinctions between production (e.g. publishing) and storage, organization, and control or access (e.g. libraries) to information, will lose their relevance as all data is electronic. Producing, finding, and reading can be virtually at the same point source.

1.5 Growth in volume of information

Fundamental to understanding issues in STI dissemination today is recognition of fact that it is information overload, not information scarcity, that is a root cause of many problems. It is not how to get more information, but rather how to cope with too much information, how to discriminate among that which is available, and how to retrieve specifically that which is needed in a timely manner.

There are a number of factors that contribute to the exponentially increasing volume of STI. They include the information technology developments which allow more, better, and faster data capture and manipulation, the so-called "big science" projects which have enormous amounts of data acquisition at the hearts of the experiments, the growth of an STI industry because of the increasing marketability of scientific data, and the ever increasing number of participants in absolute terms who generate and need STI.

This raises the issue of filters, analyzers, and synthesizers. In 1963 the President's Science Advisory Committee Report on "Science, Government, and Information" (Weinberg Report) (18) put heavy emphasis on both a new hierarchy in science where information evaluators would play an elevated role and the organization of information centers to digest the state of knowledge in specialized fields. The Committee felt the information analysis center (IAC) would help to rationalize the information process. The projected potential of neither of these concepts was ever fully realized for a complex of reasons. Just as the PSAC warned, it is very difficult to attract competent personnel who are trusted by the users to perform such activities. The reward structure in science emphasizes original works rather than works of synthesis and analysis, despite the promotion by PSAC that synthesis has a role to play not dissimilar to theory. So, the same needs and the same themes are replayed in many ways today. Information technology-based methods, including advances in expert systems, meta-analysis, and visualization, have been pointed out as possible means of achieving better analysis and synthesis. These tools have yet to make any major impact and in the short- and medium-term, many new and innovative information system options will have to be developed. The economics of analysis and evaluation services is also a major factor in their low level of availability. Data evaluation is very expensive and there is still little real understanding of the cost/benefit of such activities. Federal recognition and funding for IACs which probably reached its height in the late 1960s has been on the decline.

From within the information community (the IAC was purposely identified as a technical institute within the technical community and not a technical library), the historical approach to developing information support systems has been to obtain comprehensiveness of access. Very few (if any) of the thousands of STI bibliographic databases do any real technical evaluation. Recently there is a lot of talk about how to make searching more precise. Many database producers are going to narrower subject focus areas for databases. The use of expert systems at the front end of searching will certainly help in narrowing down choices by subject area. This will overcome some of the problems in obtaining more usable search results. However, if no scientific criteria are used in entering data into the database, then even the best systems cannot discriminate based on criteria for which there is no input.

Interestingly, the information systems community will have to find ways to provide less but more targeted and quality information if it is to serve the needs of users. This has required a rethinking of the economic basis of many services so that higher prices are paid for less but better information. It also means that users have to appreciate the value-added services and increase their willingness to pay for such services.

On the opposite end of the information lifecycle, the computer science and numeric information management communities have expressed grave concern over the current capability of computers and instrumentation to capture the volumes of information that are likely to be generated by the large science projects. Once captured on new high performance computers, means of storage for these vast quantities of data will have to be developed so they can be organized and tagged to optimize retrieval performance and use. New software systems and algorithms will need to be developed to meet these needs.

Finally, there is concern over how such large volumes of information can be archived for future use. As the information stores get larger, there is a pressing need to move it from primary to secondary and even tertiary storage devices. NASA's Earth Observing System could generate the equivalent of all 15 million books in the Library of Congress every 12 weeks. A similar problem is created by the proliferation of desktop personal computers. There is not a great deal of control over what kind of information is kept and how well it is documented. With the vastly increasing volumes of information that are capable of being captured today, there is a pressing need to take steps to safeguard the information so that it can be retrieved into the future.

Not only is there a concern over the archiving of information collected from this point forward, there is also concern over access to already archived material. Much information gathered over the past 30 years is on magnetic tape from primitive or discarded systems. An increasing portion of this information is being lost because of lack of documentation about what the tapes contain, physical decomposition, or because the equipment needed to decipher the information is no longer operational.

Finally, much of the older STI has never been put in machine readable form. It exists on microforms and on paper copy. Many of the older technology formats are now difficult to read. In the federal government alone, there are estimated to be over 4 million existing STI documents which only exist in non-electronic formats. The archival issues are themselves not new, but they are perceived as more critical today because of the volumes involved.

In forecasting and planning for STI the target is moving with the changes in science and this puts enormous stress on the producers as well as the users of the systems.

2. STATISTICAL TRENDS

A few words in general about forecasting and planning. There is a wealth of statistics about production and use of information technologies. A number of countries project regular

indicators regarding the health of science and technology. Included in some of these indicators are such STI measures as publication or patent rates. There are also many STI user studies that are conducted both from the academic and the business/organizational perspective. However, when we try to find a body of statistical indicators for STI, the task is more difficult. This was one of the outcomes of the NSF study that will be quoted from extensively. (6,7) Although its data is now about two years old, the result of the study is a large collection of data on statistical indicators of STI in the U.S. Before giving some of the finding and conclusions of that study, it is interesting to point out that the Japanese give an unusually high importance to STI indicators in their assessment of the state of their science and technology. (16) Three of the eight indicators used in their 1991 assessment are information indicators as shown below with the asterisks.

- R&D expenditure financed by private sectors
- * number of patents granted abroad
- value of exports in high-tech products
- value of exports in technology trade
- R&D expenditure financed by government
- number of Nobel Prize laureates
- * number of citation in papers from abroad
- * number of papers co-authored with foreign researchers

2.1 Use of STI by Scientists and Engineers

The current annual cost of the time of scientists and engineers employed in the U.S. is conservatively estimated at $369 billion. Forty-two percent of that time is spent on thinking, decision making, analysis, and other aspects of research, engineering, teaching, management, and administration. Fifty-eight percent of the time is spent communicating by reading, listening, observing, writing, lecturing, and advising. This amounts to over $214 billion in communication costs. Improvements in the efficiency or effectiveness of this investment could have a major impact on research and national productivity.

With regard to productivity, it is also found that information from reading saves time and resources. The average amount of savings are:

- $265 per scholarly articles
- $650 per book
- $708 per technical report

The differences among the types of publications result from the fact that reports are more often read for practical information regarding an experiment or problem whereas articles are more often read for educations or state of the knowledge considerations. It was also found that a high proportion of reading positively affects the quality and timeliness of work; the amount of reading is correlated with indicators of productivity; achievement award recipients and those on special assignments read significantly more than others; and "fast-trackers" read more than their cohorts.

With these value considerations in mind, it is interesting to note trends in traditional print STI, in data base developments, and in technology applications.

2.2 Print Publications

Looking at the books and journals trade, total journal and book publishing is increasing in absolute terms. However, there were decreases in manuscript production and in the amount of reading of journals and books per scientist and engineer from 1960 to 1985. It is also well known that prices are increasing, especially for journals. This has been at least one factor in the decrease in private journal subscriptions as well as increasing circulation from libraries and interlibrary loans. Finally, it is interesting to note that the total number of translations into English of all books does not show a distinct increase. Oriental, Russian, German, and Italian are generally increasing while the total of all other languages are generally decreasing. (These statistics are for all books and not limited to STI.) Figure 2 shows the trend in per capita publishing as noted before. Figure 3 shows the average reading of scholarly articles per year.

In the United States, the U.S. Government is the largest publisher of technical reports, a fairly important literature form in STI. Although there is no official total count of the number produced using government funds, about 50,000 are sent annually to the National Technical Information Service (NTIS). At present there is no federal deposit requirement although some agencies who provide reports to NTIS for public dissemination do have internal requirements within the agency. In 1992, a new National Technology Preeminence Act initiates the requirement of deposit of all reports produced with federal funds. Its impact is unknown as yet. Just as there has been a decline in the number of books and journal articles per researcher, it has also been calculated that there is a decreasing number of reports per R&D dollar. The reason for this is probably complex, but time constraints as well as scarce budget resources are probably contributing factors. Figure 4 shows the trend in reports per R&D budget dollar. Just as the price of journals is rising rapidly, the price of reports from NTIS has increased 39% in constant dollars from 1985 to 1990.

There is a considerable amount of international STI in U.S. agency databases, including what has traditionally been considered grey literature. In general about 20,000 technical reports are obtained from non-federal and foreign sources annually. In 1990 over 17,000 reports of foreign R&D were accessible to U.S. scientists and engineers through NTIS. Looking at the databases of the major S&T agencies, between 18% and 60% contain non-U.S. information. Much of this material is obtained through international exchanges which are very active. Figure 5 shows the percent of international data in five major federal STI databases.

2.3 Electronic Information Products

Moving from printed products to electronic databases, we see an active picture of growth and activity. The number and percentage of commercially available databases as well as their uses are all experiencing rapid growth. From 1985 to 1990, there was an increase from just over 3000 to almost 5700 databases. Of the databases available in 1990, 2,223 of them, or 39 percent, were STI. The percentage of word-oriented databases has increased, particularly as directories, newspaper databases, and chemical, patent, and company databases increased in number.

Not only is the growth in databases in numbers, but in the size per database as well. For word-oriented databases, the total size as well as the average number of records has grown sub-

stantially. The number of records grew by a factor of 69 — from 52 million in 1975 to 3.6 billion in 1990. Figure 6 shows this growth. The size of each record is also expected to grow as more databases include full text of documents.

The number of numeric databases has increased at a slower rate from 1,084 to 1,298 between 1985 and 1990. These types of databases vary from financial to materials properties to earth observation. It is in this area, particularly in the earth sciences, that the sizes of databases are projected to increase by orders of magnitudes from gigabytes (10^9) to terabytes (10^{12}). Similarly, for image databases, although the numbers are very low, the sizes in the sciences are projected to go from terabytes to petabytes (10^{15}). Figures 7 and 8 show examples of projected growth rates for scientific numeric data activities and center databases. The National Climactic Data Center as shown in Figure 7 projects to have over 500 terabytes of data by the year two thousand. Notice also the flat rate of growth of paper and other media images. The earth orbital missions in Figure 8 also show these extraordinary growth patterns. Most of these databases are not part of the survey of commercially available databases, but they are an integral, and for some researchers now, a much more critical part of the STI system. The increasing growth and accessibility of the large numeric files is important to consider in any STI planning.

Finally, there are a small number of commercially available audio and software databases, with the first ones appearing in the late 1980s. These are expected to grow considerably as multimedia and hypertext databases with audio and image data, together with authoring software, become more popular. Again, these types of databases proliferate more on private systems so the relationship with the public STI infrastructure needs to be an element of consideration.

Producers of databases grew by a factor of 7, from 200 to 2,223, with an average of three databases published per producer in 1990. It is interesting to note that, although the U.S. government is a major producer of databases, it has a decreasing proportion of total number produced from 83% in 1977 to 17% in 1990. Finally, the number of vendors also grew by a factor of eight from 105 to 850 during this 15 years. There is no STI breakdown for these growth factors.

From an international perspective, it is interesting to note that 85% of the publicly available databases were in English, 5% in French, 4% in German, with all remaining languages accounting for 1% or less of the total.

The usage of databases is also increasing by various measures. Here we have statistics specifically on STI databases. Figure 9 shows the expenditure on STI databases used growing from just over $50 million in 1982 to almost $200 million in 1989, a four-fold increase. In Figure 10 connect hours show an increase from about 750,000 to almost 1.6 million in this same time period. Finally, Figure 11 shows increases in number of STI databases used increasing from about 225 in 1982 to over 425 in 1989.

In a series of studies in the 1980s by King Research, summarized and analyzed in the NSF study (6,7), database use by scientists and engineers was studied extensively. They found that bibliographic database searches performed by scientists and engineers grew from 8.1 million in 1984 to 14.4 million in the late 1980s. This amounted to 2.5 searches per scientist and engineer. It is interesting to note that, although searches increase, the total reading is decreasing. One could speculate that searching is helping to target better reading, but this is highly speculative and perhaps optimistic, but would be an interesting hypothesis to investigate. The average time spent by scientists and engineers on searching or using bibliographic output is 1.7 hours per year. It is interesting to note that for numeric databases, the number of hours per year came to 83. This large differential in view of the commercial numeric database market statistics probably indicates that these numeric databases are generally in-house tools and are not commercially available. Another interesting finding is that there has been an increase in the use of intermediaries to perform on-line bibliographic searches. In the 1990s, 60% were done by intermediaries, a number up from 47%. Although no data is available, based on the hours spent, it is assumed that scientists and engineers do their own numeric database searching.

In addition to increased intermediary use, end-user searching is also thought to be increasing. Evidence in the medical field we have for this is related to the development of the user friendly front end, Grateful Med. This is a PC-based product that helps the user search MEDLINE, one of the more popular scientific databases. The sales of this product and the number of user codes have grown dramatically as shown in Figure 12. There is a direct correlation between the percentage of Grateful Med sales and the growth of the user population. The National Library of Medicine attributes a direct impact of the front-end aid on the end user marketplace.

Before we leave the database market, we must say a few words about CD-ROM. The portable electronic database or CD-ROM market is also one to note carefully in planning. With the introduction of CD-ROMs to the information business a few years ago, it has become a complement to on-line searching. In 1990, 428 or 50% of totally commercially available information CD-ROMs were STI databases. The growth was 2.5 times that of 1989. By 1992, almost all database producers have, or are considering, CD-ROM products.

2.4 Information Technology Indicators

If we now leave the information services market and look at the market for information technology, some other relevant facts to forecasting and planning for technical communication can be noted. Although the statistics for these industries do not relate specifically to STI usage, it is not difficult to see the impacts of the trends. Figure 13 shows revenues by information technology industry segment from 1960 to 2000 (projected). Although these are U.S. numbers, they are indicative of the worldwide industry trends. In all segments including computer equipment, software, and telecommunications, the numbers are rising dramatically with increasing rates of increase projected. Figure 14 shows shipments of computers by size. Here also we see growth rates except for mainframes; the highest rate of increase is for micros. Of course, this is quite obvious to us in our working environments, but the reality of what this means to changing patterns of communication is dramatic. To see the full picture, we need to look at one more factor — that of technical networking. Perhaps the most dramatic growth rates in adoption of new technology can be seen in the statistics related to the development of high speed scientific and educational networks. Figure 15 shows the growth of the U.S. Internet from 1987 to 1990. The number of new networks connected to the Internet increased by over 83 per month! The amount of traffic sent through the Network increased from less than 500 per month to over 7000. Carrying this forward and increasing the

network speeds, the number of networks continue to grow as shown in Figure 16, with T3 networks at 45 megabits per second catching up with T1 which operate at 1.544 megabits per second. More STI is rapidly going to more places at faster speeds.

What is also most interesting here for STI managers to look at is the use of the networks. While the origin of the high speed network in the U.S. was to connect supercomputing centers to share computer power, the actual use of the networks has largely been in communication functions. Figure 17 shows that in 1991 21% of the network traffic was for electronic mail. Another 54% was for file or data exchange. This shows that fully 75% was used for communication. The whole area of service development on the network is an interesting one for a separate paper. However, as an indicator of what is happening to the database business over the Internet, the following development is interesting to note. A new information retrieval system called WAIS (Wide Area Information Server) based on the NISO Z39.50 protocol and in this case using relevance feedback retrieval and client-server functionality was developed by Thinking Machines, Inc. of Boston, Massachusetts (11). The source code for the open protocol, information servers, and for several interfaces were made freely available over the Internet. In addition, Thinking Machines established and maintained a directory of information servers which WAIS users could search to find out about available information sources. Today the experiment has resulted in the creation of new interfaces, the availability over the Internet of more than 100 servers on three continents, and over 100,000 searches of the directory of servers. In the first six months, about 4000 users from 20 countries tried the system. They had no training other than documentation. Administrators of popular servers report that they are now getting over 50 accesses a day from many countries. (11) Although much of this access is hacking and experimenting, the powerful attraction of this technology should not be missed.

2.5 Changing Patterns in Communication

So what can we learn from the trends we have discussed? There are changing patterns in traditional forms of STC. The amount of formal documentation and reading is decreasing on a per capita basis. Traditional print publishing is changing, if not in major difficulty. There is enough evidence that scientists and engineers read few journal and spend less overall time reading. They read less, have less time for reading, are reevaluating print buying decisions based on cost of acquisitions, and are increasingly using other routes to information that are available such as electronic mediums.

There is also evidence that electronic communications are changing communication patterns in two ways. Oral and postal interpersonal communication are being replaced by electronic mail. Formal documentation may also be replaced through electronic transfer of files. These observations are consistent with the notion of the shifting paradigm in STC.

Before moving into a description of STI planning of three countries, it might be interesting to touch on some specific statistics comparing the countries covered. In a major report by the German government (15), a comparison was made of the market shares of the specialized information market for 1989. Table 1 compares the U.S., Germany, and Japan shares of the print and electronic products market. By sheer size, the U.S. has the largest single percent of any country although Europe in total has a larger percent of the print market. The U.S. dominates the electronic side and electronic STI.

Back to the NSF study, a comparison was made of Japanese and American use of foreign databases. It was found that Japanese titles represented 6.9% of titled indexing in abstracting and indexing publications in 1980. JICST journals have 52% non-Japanese journals in 1990. Although not directly comparable in dates, this relative interest in foreign material is indicative. Eight non-Japanese databases were in the top 15 used in Japan in terms of connect hours. One Japanese database was in the top 100 used in the U.S. That was the Japan Patent Information which was ranked 99 in 1989. In 1990, 38% of Japanese database users were on non-Japanese databases. Japanese database use in the U.S. is far less than 0.1%. Table 2 shows the use of on-line databases in Japan ranked by frequency of use.

3. NATIONAL STRATEGIES FOR ADDRESSING S&T COMMUNICATIONS: U.S., GERMANY, THE EUROPE COMMUNITIES, AND JAPAN

Three countries have been identified to briefly review strategies for addressing S&T communications. They are selected as a survey of differing approaches and their selection does not mean to place a value judgement on the strength or importance of their programs in the world context.

3.1 The United States

Since the shut down of the U.S. National Science Foundation Program on STI in the mid-1970s, the U.S. does not have a national strategy or program that crosses the technical lines of each individual Executive Branch Agency or Department. Rather, STI planning is primarily done within the mission of the agencies (with two major exceptions that will be discussed later). However, for the first time since the demise the U.S. Committee on STI (COSATI) in the early 1970s, the highest level science policy organization in the U.S., the Office of Science and Technology Policy (OSTP), has decided to focus on STI issues. The OSTP has an interagency coordinating structure called the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET). Over 20 independent agencies support the science mission in the U.S. through FCCSET cooperation. (9) The reason for this OSTP decision to address STI can be attributed to a few converging factors: 1) a series of policy studies, 2) the work of two other FCCSET committees on global change and high performance computing, and 3) the efforts of a number of stakeholder organizations who have promoted the issues with OSTP staff.

3.1.1 *Science Policy*

Over the past three years there have been a number of national policy studies that have looked at STC and made recommendations for national attention. The most notable of these two were the "National Academy of Sciences Study on Information Technology and the Conduct of Research: A User's View" (12) and the Office of Technology Assessment (an office of the U.S. Congress) entitled "Helping America Compete: The Role of Federal Scientific and Technical Information." (17)

The major conclusions of the former were that 1) information technology has changed the conduct of research, and on the whole, led to improvements; and 2) widespread use of information technology in research has not come about without problems, including technological, financial and underlying these, complex institution and behavioral constraints.

In the areas of data collection and analysis, the study concluded that there was uneven access to resources and problems in obtaining support for software use. There are unnecessary complexities of transmitting data over networks. Communication and collaboration among research are changing and becoming easier, more fluid, more rapid, and pervasive. Electronic storage and retrieval holds enormous potential. However, creation of databases brings up questions of data compatibility and quality. Three recommendations resulted:

1. Institutions supporting researchers must meet responsibilities to develop and support policies, services, and standards to help use information technology more productively.
2. Institutions supporting research, led by the federal government, should develop an interconnected national information technology network.
3. A national level user's group to oversee and advise on the evolution and use of information technology should be established.

The Chairman of the Study went on to conclude that from the STC perspective a new infrastructure is needed to manage STI. He concluded that what is required is a radical, not evolutionary, change. It needs to be construed broadly and to combine the support services that currently are performed today by "libraries, computer centers, telephone systems, mail services, seminar rooms, and communal coffee pots." (13, p.16) The support it could provide includes: making stores of information accessible; providing a means by which researchers can communicate over space; helping users manipulate information; and it providing both human and non-human assistance to researchers using it, i.e., it must be user-friendly. He dubbed the organizational form in the new infrastructure an "infory" rather than a "library" because the unit of measure is information not books.

The second study concluded that "STI is important not only to scientists and engineers but to political, business, and other leaders who must make decisions related to science and technology, and to the citizens who must live with the consequences of these decisions." (17, p.1) The success of the Federal STI program was seen as depending on progress in four key areas:

1. technical standard for databases and electronic document development,
2. indexing of databases and documents so information can be found,
3. adequate funding for STI in agency R&D budgets, and
4. end-user involvement in STI programs to ensure user-friendly formats and systems that meet their needs.

A strong recommendation for establishing a coordinating leadership role across individual agencies was made with FCCSET identified as the likely parent organization structure.

Two other OSTP Committees also had an influence because some of their issues are also more general STI issues. In the first case of Global Change, data managers from many U.S. agencies have been working together to prepare an interagency data and information system in support of global change research. This group found that it had to expand its interests beyond just data managers to include traditional documentation or STI managers, if it wanted to take advantage of the information science, technology, and resources potentially available to researchers. In the second case, the High Performance Computing Committee, which includes developments in networking, initially was only interested in the development of the channels of communication — the bits and bolts — rather than the content and resources that flowed through the channels. Pressure from both the library and university academic computing communities and through Congressional interests (primarily through the efforts of Senator Albert Gore of Tennessee) pushed them toward recognizing an interest in information resources. In particular, Senator Gore introduced legislation aimed specifically at information resources on the developing "National Research and Education Network". In recognition of these trends, the National Science Foundation is in the process of contracting for a major Network Information Center which will have Directory and Information Service responsibilities.

The issues that the OSTP Committee will address are currently being formulated. Being an election year and a political office, it is not certain what the effects of the OSTP initiative will be.

3.1.2 *CENDI*

Although it was noted earlier that each agency does its own STI planning, five of the major STI centers in the U.S. do joint planning and cooperate on a purely voluntary basis through a group called CENDI — an acronym of the first letter of each agency: Commerce (NTIS), Energy, NASA, National Library of Medicine, and Defense Information. CENDI is a group of senior federal STI managers who have agreed to cooperate by exchanging information, sharing resources, and undertaking joint projects. CENDI's mission is to improve the productivity of federal R&D through efficient and responsive technical information programs and improved R&D information management systems.

For FY93 some of the key areas that will be addressed include:

- Cooperatively keeping STI and R&D management aware of facts, issues and status of major legislation that might impact STI.
- Develop a focal point for business factors in STI operations.
- Work toward the development of a fully electronic life cycle management capability for full text information.
- Develop standard exchange formats and virtual linkages of agency efforts to create a directory of STI information sources.
- Continue assessment of multi-media in STI management, including format, production, management cataloging and distribution.
- Develop technology testbeds where one agency demonstration projects can be a testbed for other agency requirements
- Increase STI education, training and informational literacy addressing internal and external constituencies.

Some of the specific priority project proposals are:

- common thesaurus development

- analysis of intellectual property rights
- joint development in machine aided translation
- promoting directory services on the Internet and investigating overseas use of the Internet
- controlled environment studies on the use of information products and services
- defining criteria and evaluation quality of databases
- machine-aided indexing technology

3.1.3 *The NASA Aerospace STI Program*

Because of the decentralized nature of U.S. activity, the specific case of planning within the U.S. National Aeronautics and Space Administration (NASA) for its aerospace STI Program might be highlighted as a case study because of its particular interest to the Advisory Group For Aerospace Research & Development (AGARD).

This program is directly involved with the AGARD Technical Information Panel (TIP) and it's Director, Gladys Cotter, is the current TIP Chairman.

The NASA STI program was created as part of NASA's originating legislation in 1958. It has as its mission "to advance aerospace knowledge, contribute to U.S. competitiveness, and become an integral partner in NASA R&D programs." As part of its regular planning and operations, the NASA program reaches out to a number of different communities:

- policy community
- research community
- data community
- other agencies
- international aerospace
- technological developments

In the policy arena, it has been working through CENDI and the planning for the new STI Committee to understand what is occurring in the national information policy arena. Today there is considerable interest in public access to electronic government information, to gateways and directories for information navigation, and on issues relating dissemination principles for federal agencies.

For interaction with the research community, the NASA STI Program has an STI Council made up of senior members of the NASA research community who advise the STI Director on requirements. They have highlighted the need for modernization of systems as well as increased foreign acquisitions as two major priority areas. NASA also stays involved with a number of ongoing user studies to gain input on future needs and directions.

The data community, although part of the STI system, has historically been separated from traditional documentation managers. With the advances in technology, the differing backgrounds and traditions of these groups are being overshadowed by common problems. NASA has a senior consultant working on developing better linkages with this community. Because in the U.S. the most organized part of the data community is in the global change area and because this area is a national priority, NASA is working actively with the Interagency Working Group for Data Management for Global Change (IWG for short).

As was noted earlier, NASA is an active member of the CENDI group. Through this association, NASA learns the directions of other agencies and how to leverage its resources with them. The specifics of CENDI planning was highlighted previously.

With regard to the international aerospace community, the NASA International Program is actively involved with a number of major strategic planning activities. Its program is primarily implemented through exchange agreements at the organizational or national level. One of its main strategic planning objectives is to heighten international participation in the development of the Aerospace Database to make it more comprehensive, timely, and useful. Projects to obtain feedback from and about contributors and users have been undertaken. Active contact is also kept with AGARD TIP and with the International Council for Scientific and Technical Information (ICSTI) to keep abreast of international developments.

Finally, the NASA STI Program must constantly keep abreast of changing technologies. Many of its systems have their roots in the last generation of mainframe systems and a major modernization program is being planned. NASA staff are now looking at the following technology strategies and have initiated projects in each area (4):

- user feedback/ outreach functions
- graphic user interfaces, gateway interfaces, value-added search tools
- full text search/multi-media
- electronic publishing
- expansion of coverage through shared processing
- world-wide connectivity
- automatic translation
- support systems upgrade including enterprise-wide MIS

3.2 Germany[1]

The program of the federal government to promote information and documentation (I+D Program) was first outlined for 1974-77. It envisioned a comprehensive structural concept for future scientific and technical information services as well as the integration of previously very scattered information and documentation activities into this concept. The I+D Program intended to create 20 specialized information systems based on specialized information centers. Specialized information centers were proposed for chemistry and for the fields of energy, physics, and mathematics.

3.2.1 *Appraisal of the Specialized Information Program*

The President of the German Federal Accounting Office, as the federal official for economy in administration, presented in 1983 an "appraisal of specialized information in West Germany" which recommended a reformulation of the specialized information policy of the federal government based on the following considerations:

- The relationship between state and private infrastructure where the market sets the limiting conditions and determines, among other things, in what field state or private

[1] Much of the information contained in this section is derived from bibliography items 14 and 15.

specialized information services should be maintained

- The need for a general system of specialized information centers versus specialized information oriented according to need and promoted only in targeted areas.
- Shifting dependence on the financing of information services toward the demand and more closely monitoring the specialized information systems for greater efficiency, especially in marketing.

Twelve specialized information systems were continued in 1985-1988 including the specialized information centers for chemistry, energy, physics, mathematics, and medicine. The importance of a systematic specialized information policy was again underlined, but certain conditions were pointed out. State subsidies were more limited with increased requirements for obtaining funding from private and commercial sources. In general, the state was willing to provide funds in cases where there were overriding social or economic criteria "because areas of basic research were involved, or tasks relating to the existence and future welfare of the state, are particularly risky, laborious long-term projects that placed too great a burden on private enterprise".

For specialized information for science and research, the following principles were formulated. In general, in the case of specialized information for science and research, the state has a special responsibility because it has been shown that this specialized area does not have a large enough market to be taken on by commercially operating enterprises. In this respect, state involvement in this field is an element of indirect funding of science and research. However, it is also true that the degree to which databanks cover their costs, i.e. the ratio of expenses to income, could be improv d.

The continuance of the specialized information program of the federal government in 1990-1994 currently operates under these guidelines. The objective of the specialized information policy in future years is to ensure the comprehensive accessibility of German and international specialized information to users in West Germany with the following principles noted:

- establishment and expansion of an effective infrastructure, including scientific libraries, for the identification and accessing of specialized information in West Germany
- ensuring access to international specialized information, including international cooperation in the production, supply and sales of specialized information
- further development of the German supply by making available high-quality specialized information for domestic and foreign users
- increasing the use of specialized information, especially in colleges and research institutions, by improving the transparency of the efficiency of specialized information, in marketing and in the cost structures
- promotion of education and training in the field of specialized information
- promotion of research and development in the field of specialized information

The successes of past policies are seen as including:

- conversion of two major numeric databases in chemistry to electronic form — Beilstein and Gmelin — and making them accessible online
- improving access to German language patent information through the PATDPA (German patent Office/FIZ) and PATOS (Bertelsmann) databases
- establishment of the International Scientific and Technical Information Network (STN) German node by FIZ in Karlsruhe
- development of information agencies (information brokerage firms) in a pilot project to improve access by small and medium-sized companies to online specialized STI

3.2.2 *Future Directions*

There is recognition that further development of the specialized information market will require improvements in the following infrastructure elements: telecommunications systems and services; data security; copyright law; promotion of education and training for staff, especially in small and medium enterprises; user-friendly and efficient standards for electronic products and services; and solutions to language barriers. In the area of language barriers, it is important to be able to use English language services as well as to be able to promote German know-how and products in the English speaking world.

In the areas of marketing and user interaction, there is a theme that movement must be away from a "documentation mentality" towards one to provide innovative information services. The theme that increased used of database networks is an important tool to link electronic identification with electronic full text ordering and document delivery is cited as necessary to guarantee science and research rapid and uncomplicated access to specialized STI. These themes echo the Langenberg ideas noted previously in U.S. thinking. (13)

Scientific libraries figure significantly into German planning. It is stated that the stage has been reached where increasing demand stimulated by database searching and other factors has caused the demand of a growing number of users, in combination with the exponential growth in the quantity of specialized literature, to overstretch capacity. The solution is seen in creating regional centers, expanding local networks, and increasing the application of information technology in all library processes.

For the promotion of the future program, the following highlights some of the interesting plans for the program:

- the development of decentralized (portable) electronic information products (e.g., CD-ROM) by information suppliers
- development of simple and uniform user interfaces
- place emphasis on services to and access by small and medium-sized companies
- provision of continued support for the development of specialized literature databases in physical, math, energy, computer science, industrial chemistry, and plastics
- development of an integrated chemical and materials data systems with numeric data from Beilstein, Gmelin, among others, and in physics with Landolt-Boernstein
- Encouragement of projects of a multi-disciplinary nature
- Continue development of electronic patent information

system in cooperation with the automation plans of the European Patent Office as well as those in the U.S. and Japan

- Promotion of pilot projects to link bibliographic searching with ordering and document delivery
- Promotion of research in publishing to maintain a fully electronic and integrated life cycle including data, text, illustrations, graphics, and sound with out "media breaks"
- Improvement of user interfaces with natural language access and expert systems elements to guide the user
- Promotion of machine-aided translation through work on German electronic dictionaries and research in computational linguistics

Finally, German policy recognizes the necessity of international cooperation in the preparation and supply of STI and the existence of the world market. To this end, there is both commitment to bilateral as well European cooperation.

In one specific instance of particular interest to the AGARD aerospace community, FIZ Karlsruhe has taken on the responsibility to develop a German Aerospace Database. The purpose of this effort, which has the cooperation of many German aerospace companies, is to:

1. document German know-how
2. complement the NASA database
3. form a basis for bilateral cooperation
4. form the basis for European cooperation (1)

3.3 Japan

By now most of us have heard that the Japanese word for information is "Joho" which has its derivation from the term specifically meaning "military intelligence." In this context, the Japanese perspective is an interesting one. The use of information and information systems as tools is highly developed and integrated into the Japanese research approach. For example, as noted previously, the use of publication, patent, and citation analysis plays heavily in the national look at science and technology policy review. (16)

3.3.1 *Information*

The Japan Information Processing Development Center (JIPDEC)'s 1991 Edition of its "Informatization White Paper", (10) highlights MITI's "Trade and Industry Policy Visions for the 1990's" as indicating that, "further promotion of informatization, together with the encouragement of science and technology, will be one of the important pillars for securing a 'foundation for economic development'". [Section I.1] According to the White Paper, the concept of informatization extends to daily life. They believe that information comes to have increasing value in people's lives. In business individuals are now required to acquire positively and use knowledge creatively without merely depending on the information given to them. They also conclude that people have recently been placing more importance on time. The growing use of electronic devises such as VCRs, answering machines, fax machines, and electronic mail are used because they set the user free from time constraints. Such machines enable constant access to "information space" and will exert increasing influence on daily and business life. This notion clearly echoes the U.S. statistics indicating increasing time pressures on scientists and engineers.

3.3.2 *Strategy for STI Distribution*

As part of its major "White Paper on Science and Technology: 1990" (19) the Science and Technology Agency of the Japanese Government laid out the strategy for it national distribution of scientific and technological information. This is in the context of the promotion of research. The government states that STI is a major component of the infrastructure for promoting R&D along with increased expenditures on R&D, nurturing personnel, improving equipment and facilities, promotion of research exchange, regional initiatives, and the private sector. (19, p.250)

The increasing volume of research information is seen as an impediment to the access to needed information and necessitates increasing attention to be given to gathering and organizing information "into easily referenced systems, which can then be supplied on demand to individual users in the requested form." (19, p.257) This is another theme that echoes from the issues noted previously. In 1969 the basic concept of a National Information System for Science and Technology was defined. In 1989 the following were emphasized as national objectives:

- reinforcement of the information distribution infrastructure with an emphasis on improvement of the quality of information and ensuring easy access to information by users
- further international distribution of information and the dissemination of information among regional areas in Japan
- intensified and broader information collection
- more advanced information dissemination capabilities

3.3.3 *Structure of Dissemination Activities*

The structure of information dissemination activities includes:

- The National Diet Library, which collects domestic and foreign S&T publications, builds indexing databases and provides document delivery. It also has the authority for deposit of all unclassified publications issued in Japan although the R&D reports written through private industrial research are not generally represented in this collection.
- The Japan Information Center of Science and Technology (JICST) within the Science and Technology Agency is the central focus in Japan for building the main international database of scientific and technical literature (adding 640,000 items annually) as well as developing reference databases. It disseminates Japanese government publications and has a major role as the Japanese STI vendor as a partner with Chemical Abstracts and FEZ Karlsruhe in the STN Network.
- The National Center for Science Information System (NACSIS) which is responsible for planning and coordination of systems for scientific information, establishment of networks, and provision of information services in the public university structure. NACSIS has done a lot to upgrade the skills of Japanese librarians, particularly in the information technology areas such as library automation. It's parent agency, the Ministry of Education, focuses on assisting university research faculty with support for publishing database development, and computer access.

- The Patent Agency under the Ministry of International Trade and industry (MITI) is responsible for development of a database and retrieval system for patents. Also under MITI is the Agency of Industrial Science and Technology (AIST) which participates in the development of international standards, a high priority activity for Japanese industry.

In addition, a number of the Japanese federal agencies have information programs in their mission areas including the Japan Atomic Energy Research Institute which cooperates on building the International Nuclear Information System, the national Environment Research Institute which collects data and builds databases on the on the environment, and the Medical Information Systems Development Activities under the Ministry of Health and Welfare for medical information systems, among others.

3.3.4 *Technology Developments*

Three technology development thrusts highlighted in the Science White Paper that relate to the STI dissemination program are:

1) research on a knowledge-based system to support the design of chemical substances
2) building a self-organizing, information-based system to assist creative R&D
3) full-text database prototype development program in the Japanese language

In addition to its program for dissemination of STI, there are two other components to Japanese planning that relate to STI. One is the development of information science and technology including information processing and human interfaces, and information transmission. The Japanese see advances in information processing technology as a plus not only for quantitative improvements such as higher speed and increased capacity, but also qualitative improvements such as machine interpretation of information at a conceptual level. (19, p.189) Highlights include:

- research into fuzzy logic and neural network systems and their applicability to user interfaces and non-linear logic-based systems to achieve capabilities such as inductive reasoning, and manipulation of imprecise knowledge.
- development of a practical machine translation system
- fifth generation computer R&D

Not mentioned in the White Paper, but recently announced is the new Fourth Dimension Project which will attempt to integrate the technology development from the 5th Generation Program with the software and the advanced knowledge-based research to create a system that can have intelligent responses, including a system that can comprehend conversations!

Among the major scientific nations of the world, Japan has the special problem of having a qualitatively different language structure. This makes the issue of translation a particularly more important one. Japan looks to this problem in two ways: 1) to have effective Japanese-English-Japanese translation, and 2) to have effective translation among the Asian languages through an intermediate language. These are the thrusts of machine translation activities, an important activity in Japanese STC planning.

Japan recognizes the importance of the informal communications network of person to person contact. There is a 15 to 1 differential in terms of exchanges of scientific personnel for study and collaborative R&D between the U.S. and Japan. (9)

Japan, because of its economic success, has been the focus of pressure from other countries to be more forthcoming in sharing its information resources internationally. In contrast, Japan indicates a major understanding and commitment to the "globalization" of scientific and technological activity. The Japanese recognize the necessity of the world wide cooperation. To this end a large part of the JICST Database containing Japanese citations was translated into English to accommodate requests for better access to Japanese information. In addition, through a cooperative effort with the U.S. National Science Foundation and the Library of Congress, the NACSIS System and databases (conference proceedings, directory of university researchers, economic database, among others) are available in the U.S. only for the cost of the telecommunications used. In fact, the equipment needed to access the system was also provided free of charge. Of course, it is the responsibility of the customer to be able to read and communicate in Japanese.

Finally, it is interesting to highlight the commitment of Japan to international partnerships, particularly with the U.S. In 1988, a science and technology agreement was signed at the presidential level between the two countries. This level of signature for a science protocol was noteworthy itself. Of further interest is that the agreement had provisions for improving scientific and technical communication between the two countries including the exchange of grey literature and the sharing of machine translation developments.[2]

4. OBSERVATIONS AND CONCLUSIONS

If we look at the trends, the common themes in planning across our examples, we can make the following observations:

- In general, federal programs are recognizing the fundamental changes in science and scientific research. There is recognition of the need for a new infrastructure and organizations and nations are exploring both the technological (e.g. networking, multi-media, user friendly interfaces, full text electronic) as well as the economic, social and political implications (e.g. copyright, privacy, user education and marketing).
- Internationalization of STC is clearly a theme both from the point of view of resource availability as well as from the aspect of communications.
- The language barrier to gaining competitive advantage through information is real. The Japanese have the biggest problem and are applying technology and priority to it. The Germans, as part of the European Community have long dealt with it. The U.S. in its position of losing market share, especially to the Japanese, as well as its interest in certain technologies in Russia, the Orient, and Germany, is now becoming increasingly aware of the language barrier. With advances in technology, machine translation now appears on everyone's technology priority list.

[2] Appreciation is expressed to Glenn Hoetker of the NASA International STI Program for some of his suggestions and insights into the Japanese perspective.

- The importance of an electronic full text life cycle is well recognized.
- The importance of universal literacy with aides to small and medium sized businesses as a competitive resource is being recognized. The Japanese call it "informatization"; the German's have set up a pilot project of information brokers; the U.S. is beginning to accept the concepts as shown in the Wood report, but are coming along slowly in terms of implementation in national policy context.

If we are, in fact, in the midst of a changing paradigm in STI from a print based to a networked based environment, then it is especially important to be flexible and stay alert and sensitive to changing directions and new opportunities.

In general, the Japanese are voracious users of statistics and gatherers of information. It is part of the research culture and pervades their informal and interpersonal information seeking activities as much as their use of formal communications. However, they are also leaders in and admirers of advanced information technologies. To this extent they may, in fact, be the best prepared for the shifting paradigm. Because they have less invested in the traditional STI structure, they have an opportunity to leapfrog the inertia of other nations in the application of new technology to STC.

The U.S. is probably the most advanced country with its development of high speed networking. However, with it's less aggressive approach to national STI strategy, it is not clear that it will fully capitalize on the opportunities that are presented. We are in the midst of enormous flux. With a few additional initiatives that recognize the importance of developing the STI services through the networks (like the second Gore Bill), events may turn quickly for the better.

The Germans fall somewhere between the other two countries in that they have a will and plan for a coordinated, content based STI infrastructure. Their focus on getting small and medium sized industry to become more information literate is a difficult one, but if successful will be a winning strategy.

Although the root causes of issues relating to effective scientific and technical communications such as information volume, advances in technology, etc. were cited earlier, it is interesting to reflect on at least one of the primary results: lack of time. The Japanese "Informatization White Paper" (10) brought the point home when it said that the reason information technologies are being adopted so rapidly is because they set the user free from time constraints. They enable constant access to "information space." In the earlier citation of statistics, it was noted that there was increasing demands on the time of scientists and engineers and they are reading less. Juxtaposing these two points we see one of the drivers toward the shifting paradigm. For planning and forecasting in STC, changing patterns must go in the direction to help solve the problem of constraints of time for the scientist or engineer.

Two last observations are non-text but rather graphics and images. They are transnational and transcultural. And they are aeronautically oriented. First, we remember the statistics on the growth of computer sales. Figure 18 shows the growth of sales of laptop computers from 0.016 billion ten years ago to 4.1 billion in 1992. The final thought in planning and forecasting in scientific and technical communications is shown in Figure 19. The scientist and engineer, while traveling the world, will be ordering batteries, not beer!

APPENDIX

PREFACE

INFORMATION TECHNOLOGY ISSUES
- Advances in Technology
- Next-Generation Information System Problems/Issues
- Pace of Technology Development
- Development of Computer Networks
- Perception of Technology
- Standards
- Military Applications
- Other Technology Issues

POLICY, STRUCTURAL AND INSTITUTIONAL ISSUES
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- Information Policy Issues
- Public/Private Sector Roles and Relationships
- Relationships Among the Branches of Government
- Relationships Among the Technical Stakeholders
- Relationships Among Text, Numeric, and Image Providers

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- Intellectual Property
- Ethical Issues

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- Market Creation
- Funding and Financing

ISSUES OF CONTENT AND ACCESS
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- Information Content: Quality, Comprehensiveness, Currency
- Access and Dissemination
- Security Issues

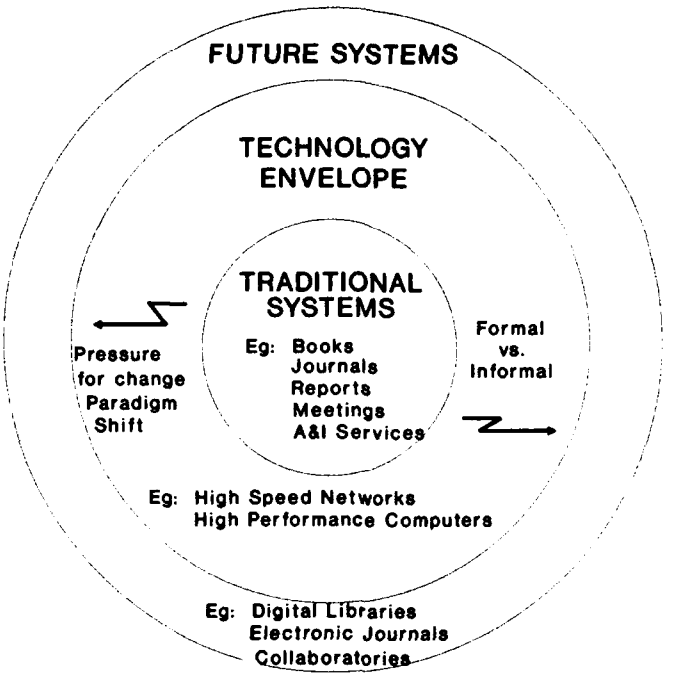
ATTITUDINAL AND BEHAVIORAL ISSUES

EDUCATION/TRAINING ISSUES

INTERNATIONAL ISSUES FOR STI ACCESS
- Exchange of STI
- Transborder Data Flow
- Privacy/Security
- Political, Economic, and Social Considerations
- Acquisitions and Mergers of U.S. Information Companies
- Pricing/Currencies
- Information to be Exchanged/Transferred/Sold
- The Balance of STI Database Use
- Language and Translation
- Telecommunications
- Communicability, Compatibility, and Standards
- Copyright, Data Rights

APPENDIX A: Classified List of Issues Raised in Literature and Stakeholder Discussions

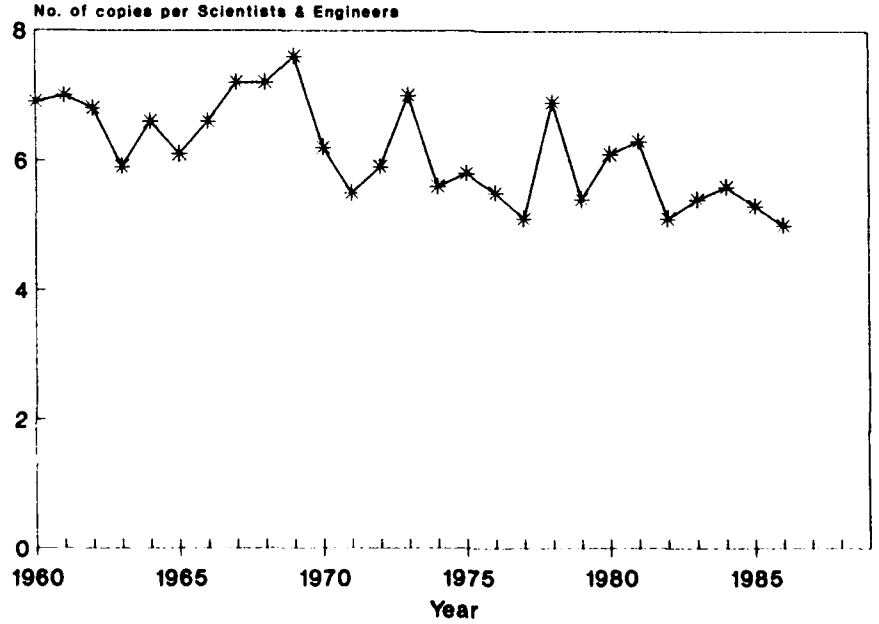
FIGURE 1.



MODEL FOR DEVELOPING FUTURE STRATEGIES IN STI MANAGEMENT

FIGURE 2.

Number of Copies of Scientific and Technical Books Published per Total Scientists and Engineers: 1960-1989



SOURCES: The Bowker Annual of Library and Book Trade Information, Eds. 8-35, (New York: R.R. Bowker, Co., 1962-1990); National Science Foundation (NSF), Science and Engineering Personnel: A National Overview (Wash., D.C.:NSF, 1990) NSF 90-310

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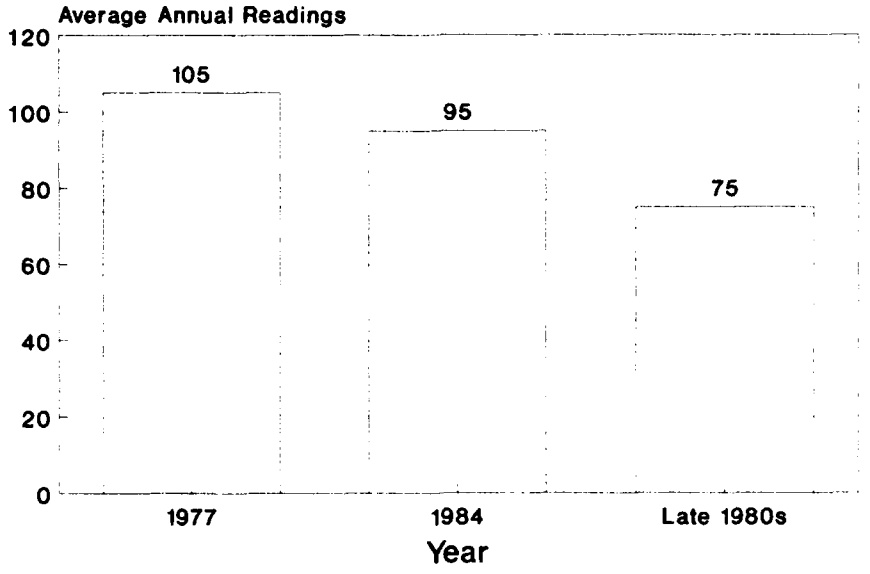
FIGURE 3.
Average Readings of Scholarly Articles per Year: U.S. 1877, 1984 and Late 1980s



SOURCE: King Research, Inc.

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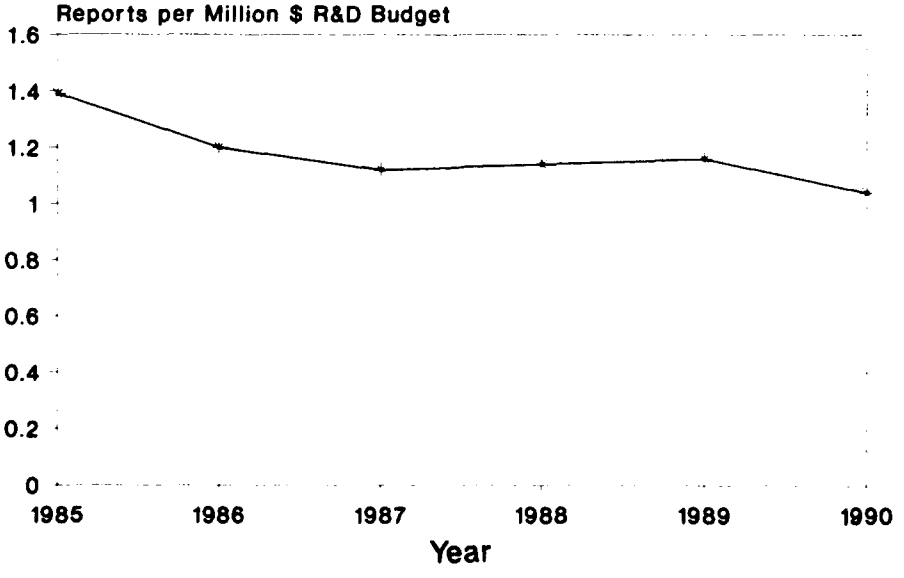
FIGURE 4.
Technical Reports Made Available Through NTIS per R&D Budget: 1985-1990



SOURCE: Personal communication with NTIS

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FIGURE 5.
Percentage of U.S. vs. Foreign Records in Selected Agency Databases

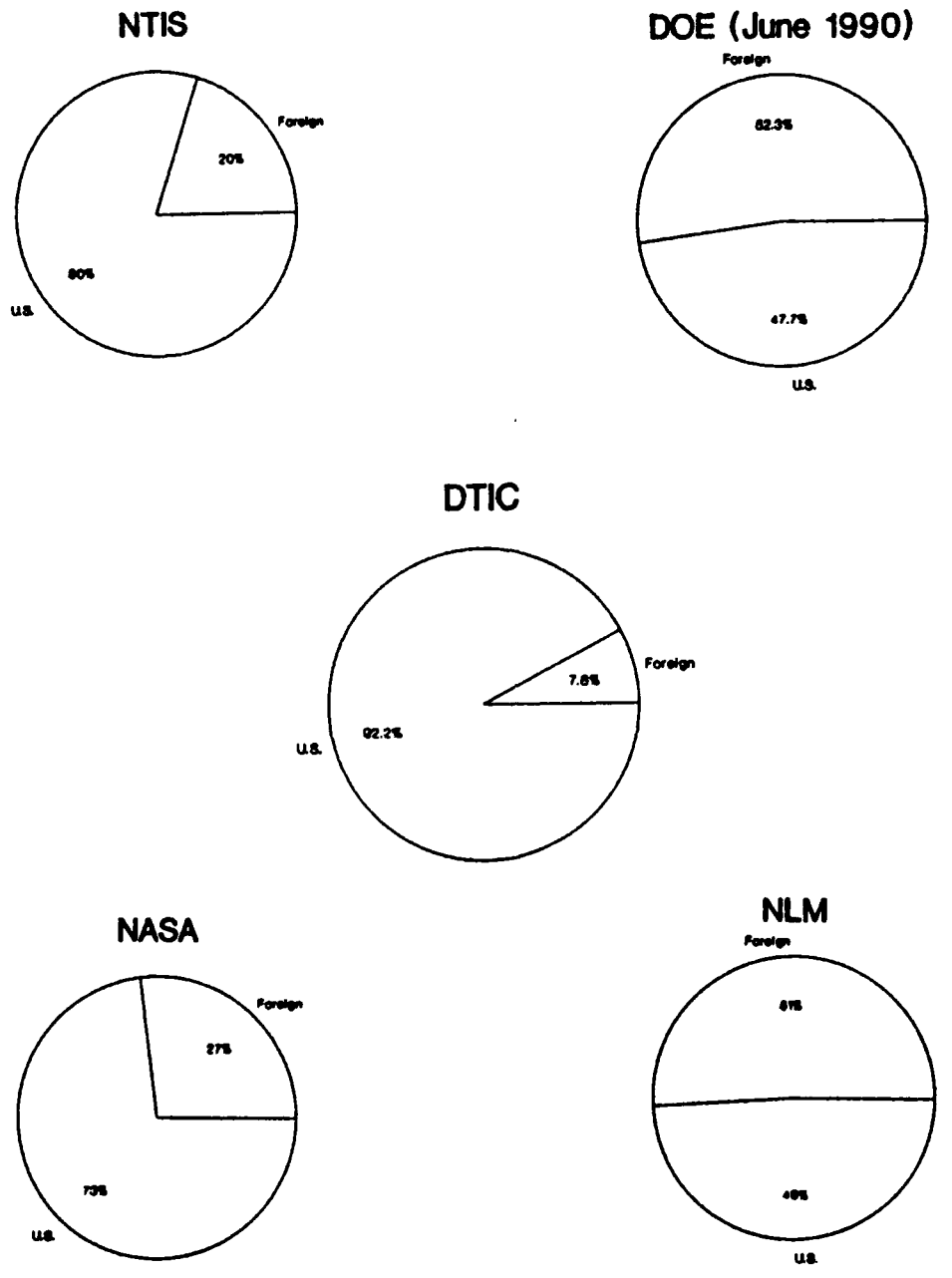

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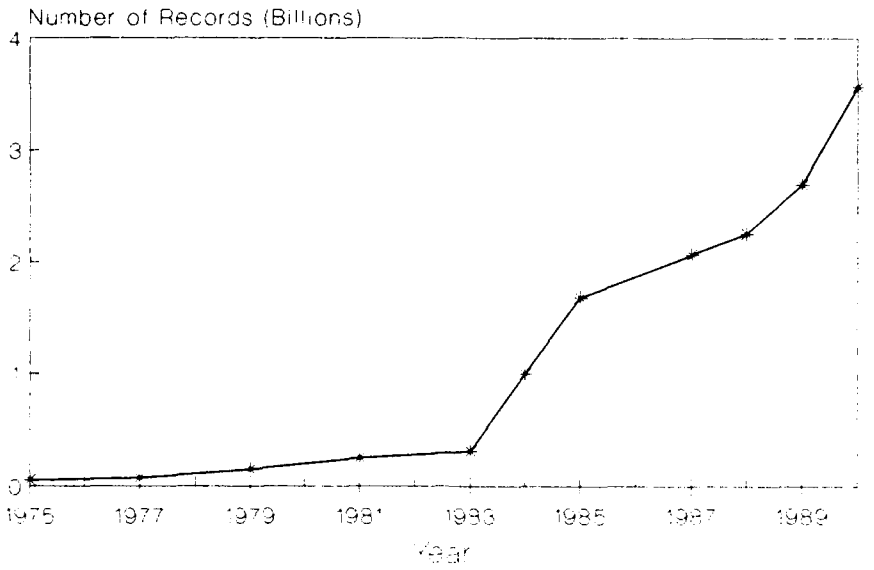
FIGURE 6.
Growth in Numbers of Database Records: 1975-1990



SOURCE: Martha E. Williams, "The State of Databases Today: 1991," in Computer-Readable Databases: A Directory and Data Sourcebook, eds. Kathleen Marcaccio, Julie Adams, and Kathleen J. Edgar (Detroit, MI: Gale Research, Inc., 1991) ix-xvii.

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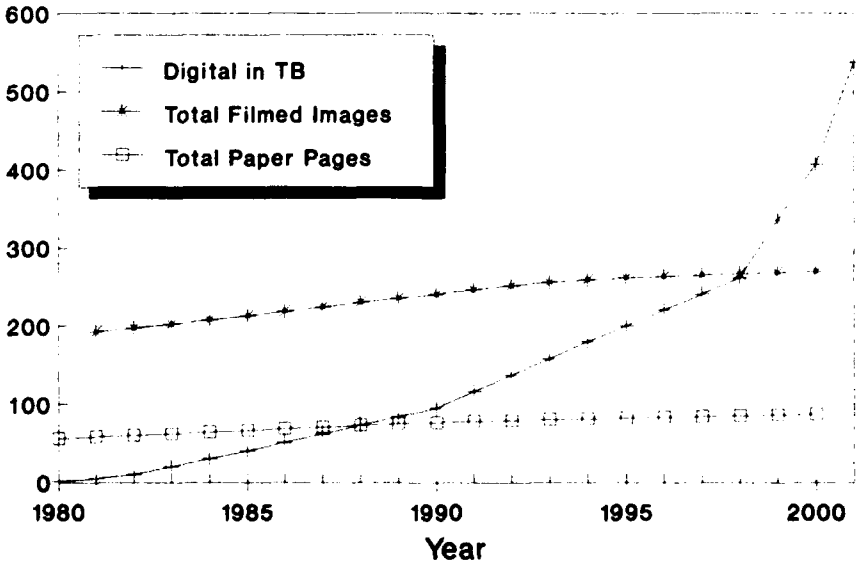
FIGURE 7.
NCDC Data Resources by Storage Media: 1980-2001



SOURCE: Personal communication with NCDC Systems Development Staff.

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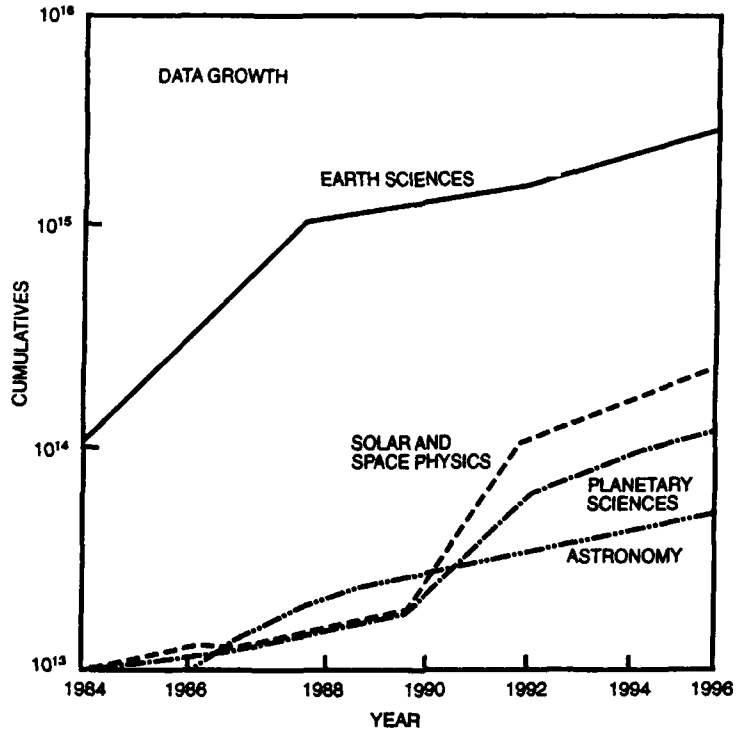
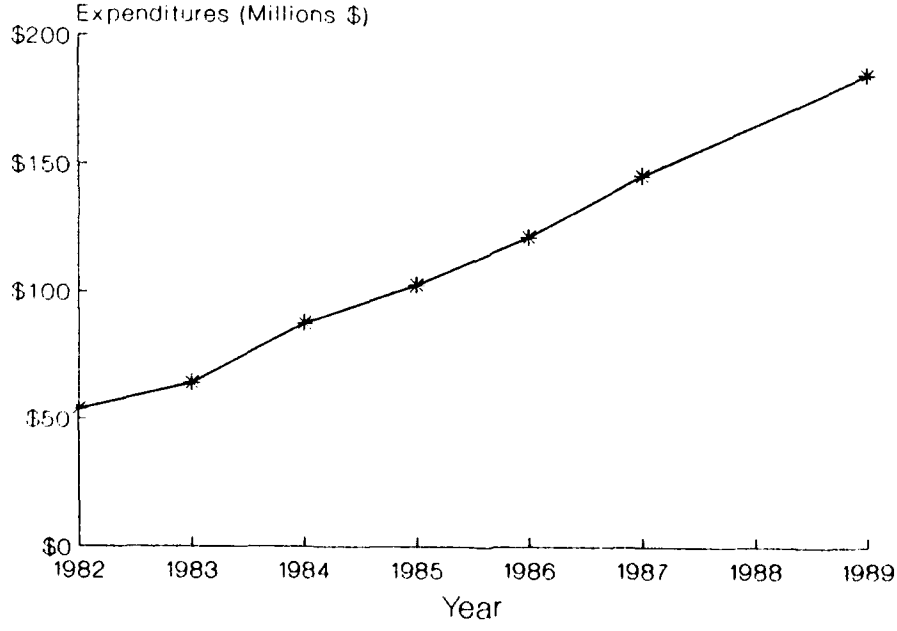
FIGURE 8.
Projected Growth Rates for Space Science Data



NOTE: Earth orbital missions assumed to last for 5 years, except for operational satellites and the space telescope, which are projected as continuing data producers.

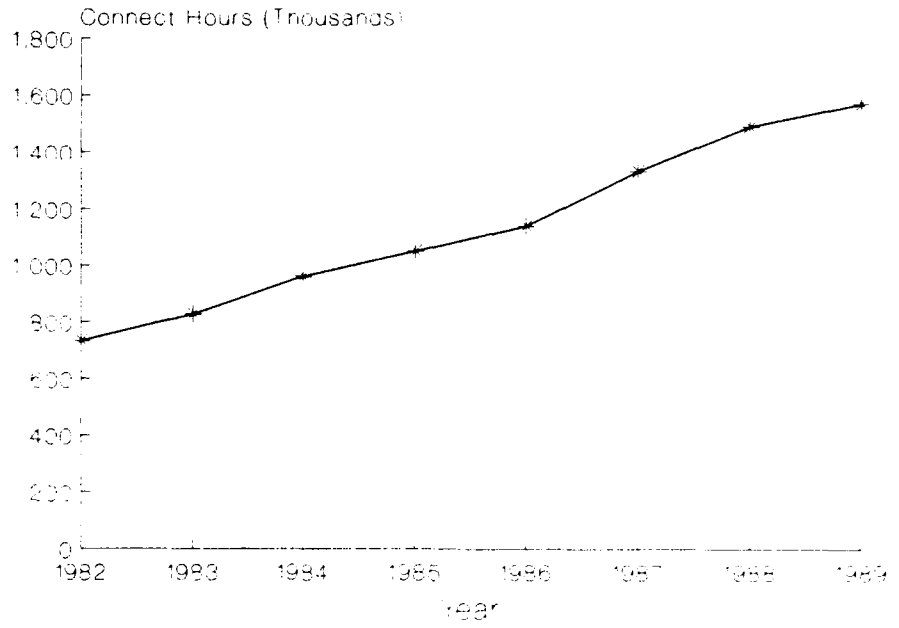
FIGURE 9.
Expenditure on STI Databases Used in the U.S. Information Center/Library Market: 1982-1989



SOURCE: Martha E. Williams, Information Market Indicators Reports (Monticello, IL: Information Market Indictors, Inc.)

Reprinted from: Description of Scientific and Technical Information in the United States: Current Status and Trends. Volume I. Knoxville, TN, University of Tennessee Center for Information Studies for the National Science Foundation. July 1991.

FIGURE 10.
Connect Hours of STI Databases Used in the U.S. Information Center/Library Market: 1982-1989



SOURCE: Martha E. Williams, Information Market Indicators Reports (Monticello, IL: Information Market Indictors, Inc.)

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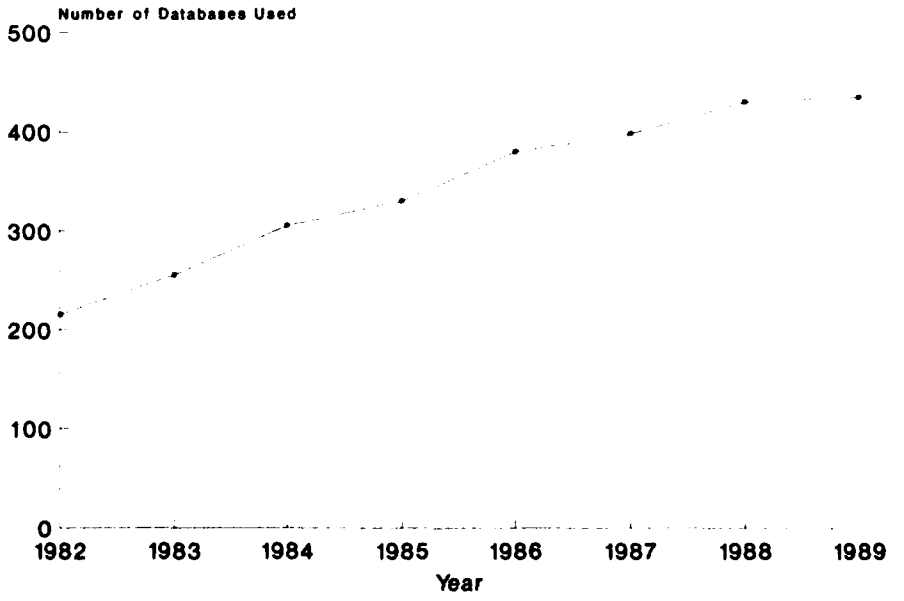
FIGURE 11.
Number of STI Databases Used in the U.S. Information Center/Library Market: 1982-1989



SOURCE: Martha E. Williams, Information Market Indicators Reports (Monticello, IL: Information Market Indicators, Inc.).

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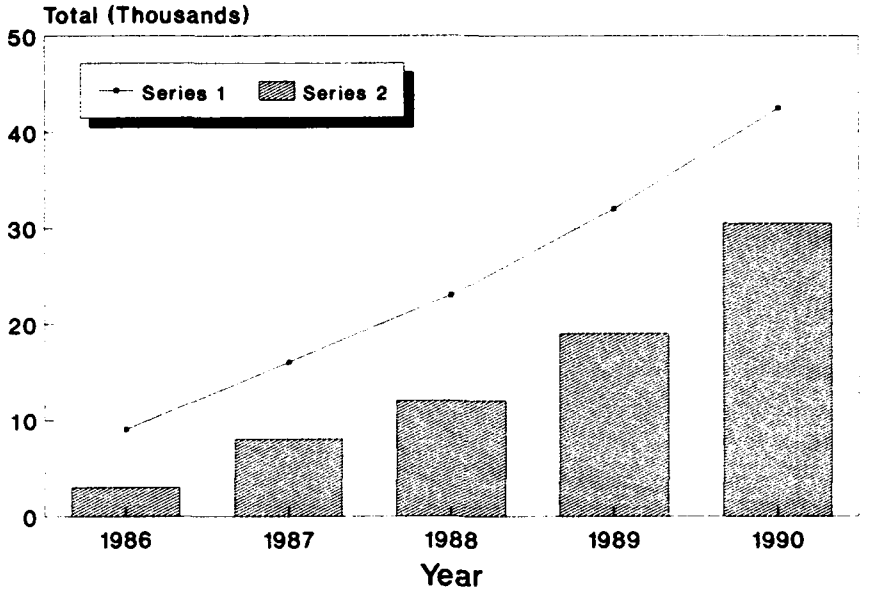
FIGURE 12.
User Codes and Grateful Med Sales: 1986-1990



SOURCE: Personal communication with NLM.

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FIGURE 13.
Worldwide Revenues of U.S. Information Technology Industry by Segment: 1960-2000 Projections

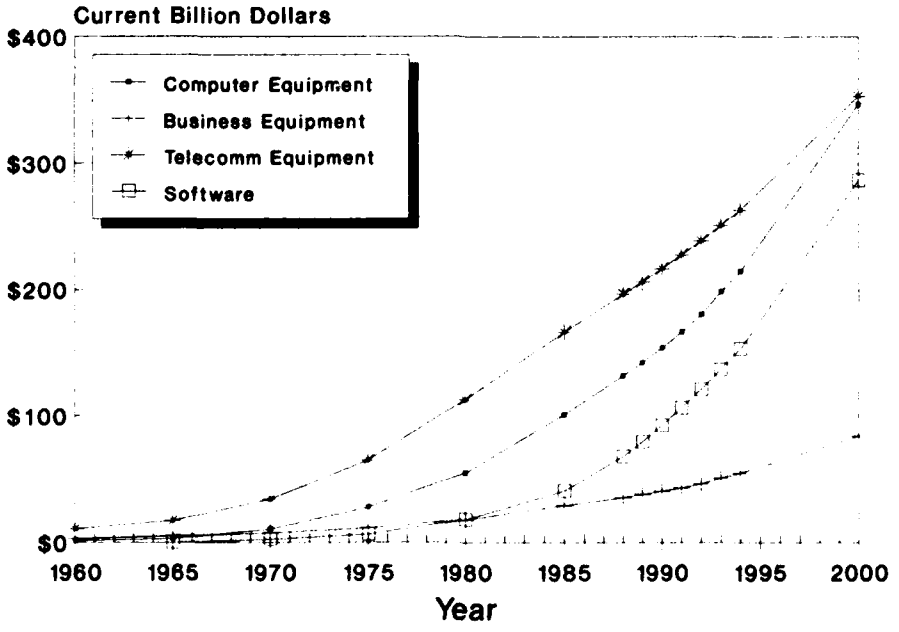

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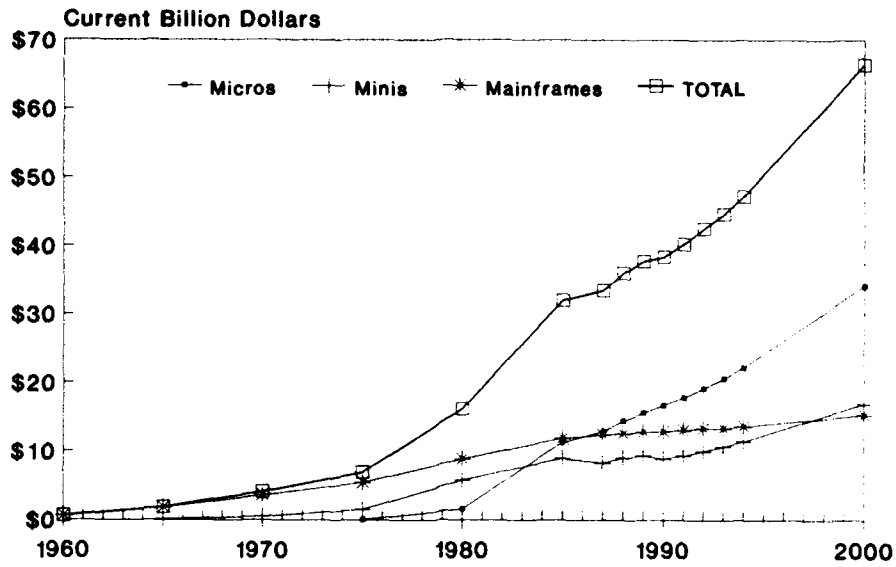
FIGURE 14.
Domestic Shipments of Computers by Size: 1960-1988 and 1989-2000 Projections



SOURCE: CBEMA, The Information Technology Industry Data Book, 1960-2000 (Washington, DC: CBEMA Industry Marketing Statistics, 1990).

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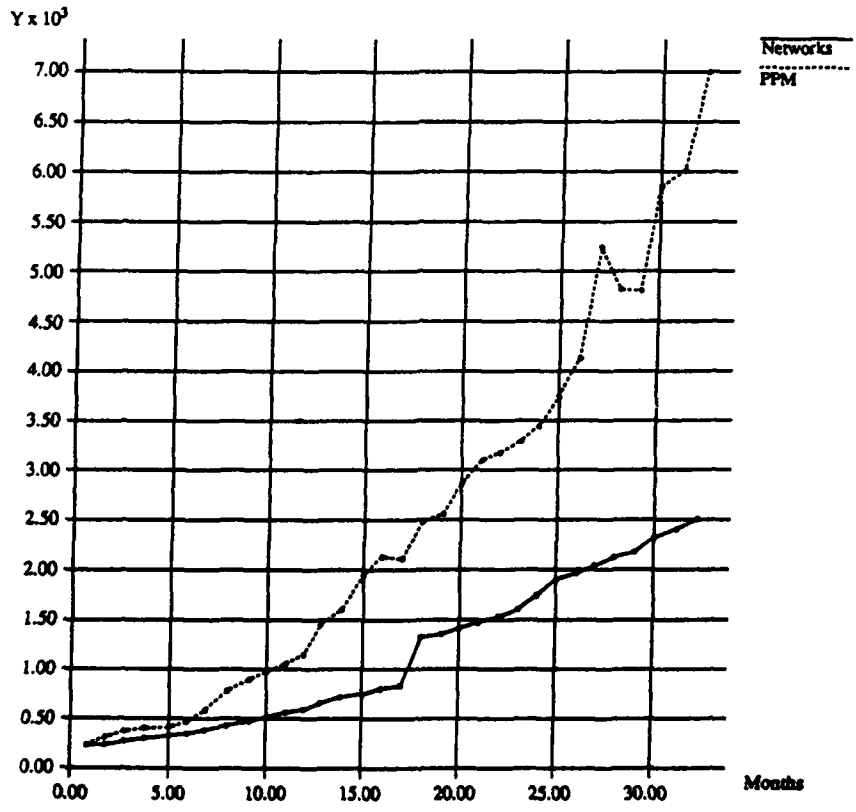
FIGURE 15.
NSFNET Announced Nets and Packets/Month v/s Months



SOURCE: N.S. National Science Foundation

FIGURE 16.

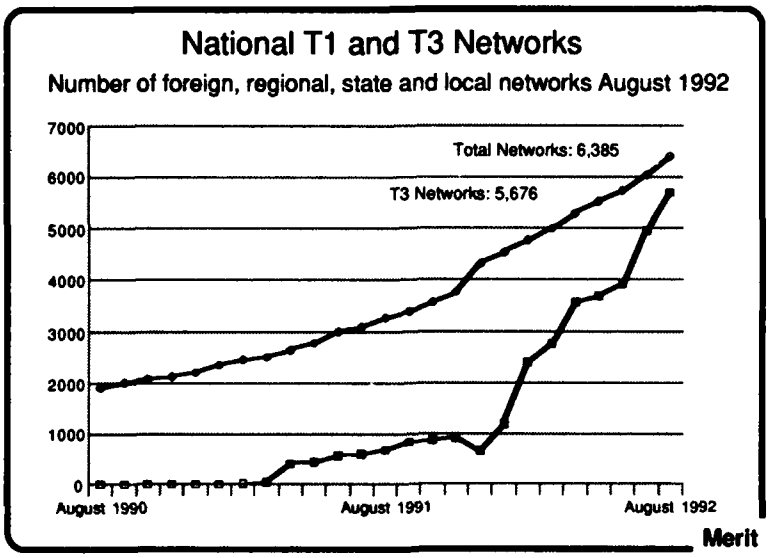


FIGURE 17.

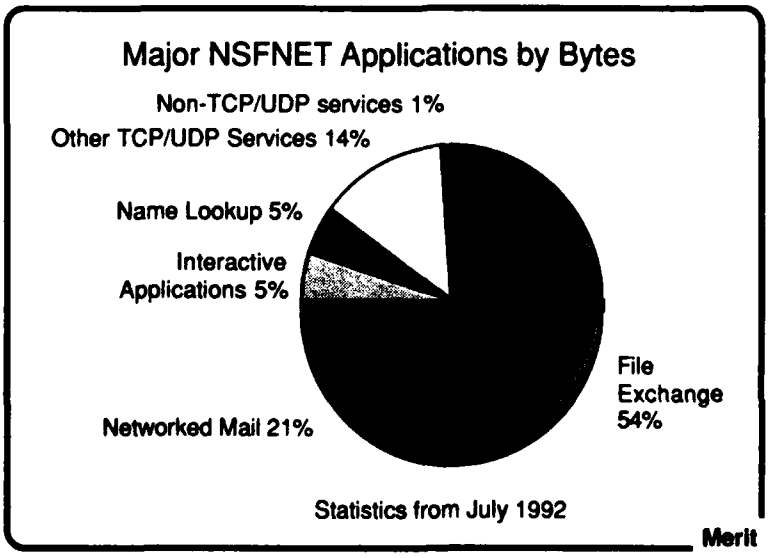
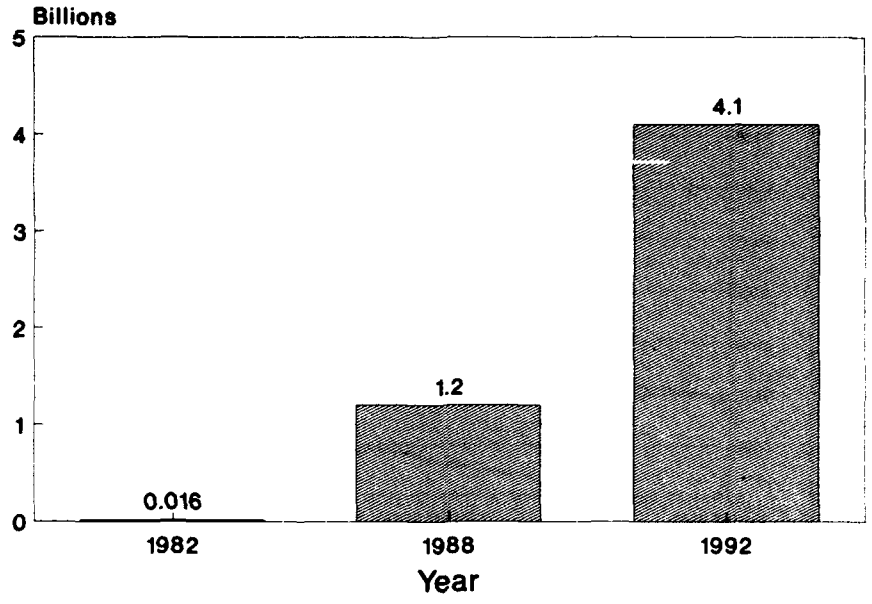


FIGURE 18.
Sales of Laptop Computers



SOURCE: Dataquest

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FIGURE 19.

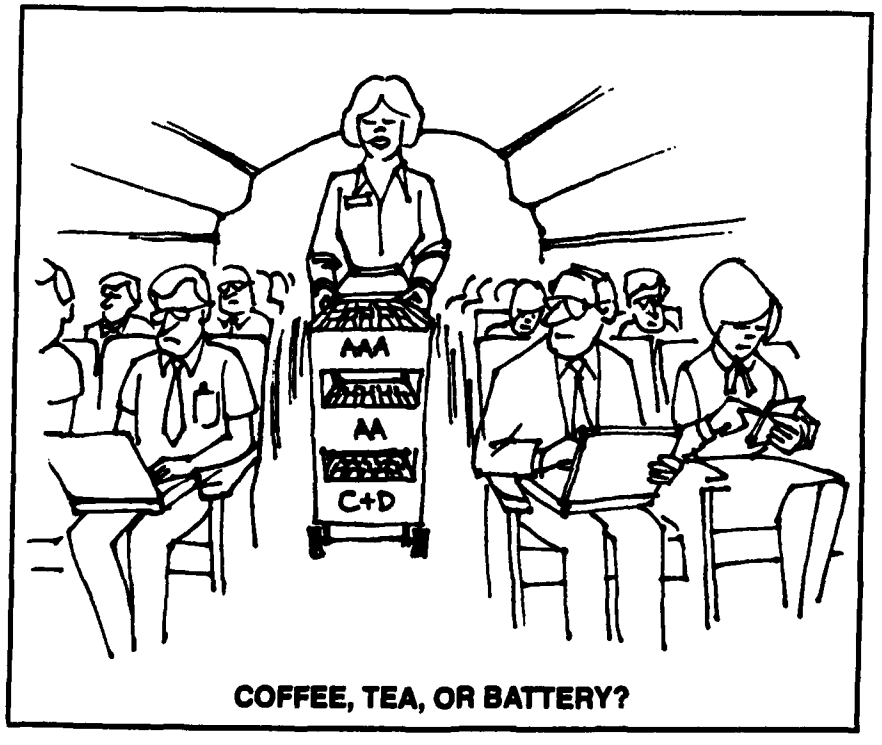

TABLE 1.

Comparison of Market Shares of the Specialized Information Market, 1989

	Share of the Market	U.S.	Germany	Japan	Rest of Europe
Printed Products	96	38	9	13	40
Electronic Products	4	57	3	12	29
Electronic STI Products	7	58	7	14	21

SOURCE: Specialized Information-Programme of the Federal Government 1990-1994

TABLE 2.

Online Databases Used in Japan Ranked By Frequency of Use in Decreasing Order: 1989-1990

1990	1989	NUMBER OF RESPONSES	DATABASES
1	1	190	JICST Sci/Tech/Ind
2	3	166	Nikkei News Art.
3	2	155	Patents
4	5	75	WPI
5	9	67	AHAHI News Art.
5	6	67	CA-SEARCH
7	10	62	Trademark
8	8	58	CA
9	4	57	MEDLINE
10	7	45	JICST Med
11	14	38	CLAIMS
12	11	32	NIKKEI
13	12	30	INSPEC
14	13	28	BIOSIS
15		28	COSMOS

SOURCE: Data extracted from: Database White Paper, Part 3, State of Database Usage, "Survey of Usage of Database Services, DPC," (1990) [In Japanese].

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IMPACT OF CHANGING INTERNATIONAL RELATIONS, MARKETS AND TECHNOLOGIES ON THE SCIENTIFIC AND TECHNICAL COMMUNITY

Technical Information Panel Specialists' Meeting
Copenhagen, Denmark 14th—15th October, 1992

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